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In This Issue

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RECOGNITION

The performance of the railroads of this country during 1935—18,400,000,000 passenger miles without a passenger fatality due to a train accident—is deserving of the greatest recognition. » » » Rendering complete service 365 days a year under all conditions of weather, hauling heavier loads at lower costs and faster speeds, the railroads today are a safe, sure and indispensable transportation means. » » » Hand in hand with the transportation developments responsible for this remarkable performance has gone the development of new steels that contribute greater reliability and strength, and longer life. » » » Republic has been in the forefront of this metallurgical progress and is today the world's largest producer of alloy steels for railroad service. Send for booklet on alloy steels. » » » » »

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RAILWAY AGE

High Wages and Continued Unemployment

The American Federation of Labor recently estimated that the number of unemployed in January was 12,626,000, an increase of 1,229,000 over December. It blamed "lengthened working hours and slackened manufacturing operations" for the increase. "It indicates," said the Federation, "that industry is making no determined effort to put the unemployed to work and is quite willing to shirk all responsibility for them." The implication that industry does not want to put the unemployed to work is so obviously false as to be unworthy of comment. Why industry does not put them to work merits thorough study, profound consideration and intelligent and courageous discussion. It may be being given such study and consideration by more persons than we know of; but it is being given almost no public discussion.

To what extent is the continuance of unemployment due to present wage scales in certain large industries? New Deal politicians are committed to short hours of work and high hourly wages as means of restoring prosperity, and made them the principal, and finally almost the only, policy of NRA. Anti-New Deal politicians will not publicly attack this policy for obvious reasons. But it is a fact that almost all the improvement in business within the last three years has occurred since the Supreme Court's decision destroying NRA. It is also a fact that we have now had almost six years of the worst depression in all history, and that the increase of business that has occurred since the bottom was reached almost four years ago has been equivalent to only about one-third of the decline that occurred. To talk as if recovery had been accomplished is absurd. There were causes of the depression. There have been causes of its continuance. There are causes of the national income still being less than two-thirds of what it was six years ago.

In a thorough, impartial and scientific study the Brookings Institution concluded that this depression was principally due to maldistribution of income, and plainly implied that NRA and other similar policies tended to prevent the redistribution of income necessary to recovery. The maldistribution which its conclusions principally indicated was between certain industries and their employees, on the one hand, and the rest of the population, on the other hand. It is well worth inquiring whether this maldistribution continues, and is perhaps the principal reason why depression and unemployment continue.

We are raising an unpopular question—whether wages in certain industries have not been, and are not now, too high. It has become a generally accepted doctrine that high wages for labor promote prosperity, and are necessary, when it has been lost, to its restoration. That does not prove it sound. If all the economic doctrines accepted by politicians and business men had been sound we would not have had the depression.

What is "Labor"?

Nobody questions that labor should be well paid. But it is high time to raise a question as to what is "labor," and what are merely high, and what are excessive, wages under any given condition. In 1930 there were almost 50,000,000 persons "gainfully employed" in the United States. They all worked. But when "labor" is mentioned, are all of them referred to? Obviously not. Otherwise, why is not the talk about the desirability of all who work having high incomes and large purchasing power? The use of the word "labor" in the sense in which it is now ordinarily used was originated by labor union leaders for their own purposes; it has been adopted by politicians for their own purposes; and it has become general among persons who do not stop to think what they mean. It does not mean farmers or their employees, or professional men and their employees, or domestic servants,

or small storekeepers, or numerous other classes of persons.

Why So Much Solicitude About "Labor"?

What it means is manual workers in manufacturing, transportation, mining, construction and a few other industries. They constitute about 40 per cent of all who were "gainfully employed" in 1930, and a smaller percentage of those gainfully employed at present. Just why should they constantly be the especial objects of so much economic and political solicitude? They are accorded it upon the assumptions that they constitute the bulk of the working population; that they are in especial danger of economic exploitation by employers; and that their purchasing power is of especial importance. None of these assumptions is correct. They constitute only two-fifths of the actual working population. The relatively great increases in their average hourly wages that have occurred show they are not in especial danger of economic exploitation. Their purchasing power cannot be of more importance than that of the rest of the population, because they and their families constitute only about two-fifths of the population.

From the standpoint of the economic welfare of the entire population, then, how long hours is it desirable that they should work and how high wages should they receive? They have to buy commodities and services provided by the other three-fifths of the population, and it is desirable that they should afford a good market for the other three-fifths. It is equally true, however, that the other three-fifths buy the commodities and services they provide, and that it is desirable that the three-fifths shall afford a good market for the two-fifths. Obviously, therefore, the incomes of what is called "labor," on the one hand, and of the rest of the population, on the other hand, should be proportionate to their respective contributions to the total amount of commodities and services provided. If "labor" does not get income in proportion to its contribution to the total volume of commodities and services provided, it will be exploited by those who buy the commodities and services that it helps to provide. On the other hand, if "labor" gets income higher in proportion to its contribution to the total production of commodities and services than the rest of the population, then labor will exploit the rest of the population.

Actual and Proposed Increases in Railway Wages

Now, what does the available data indicate regarding the way in which the national income has been, and is now being divided between what is called "labor," and the rest of the population? Let us first consider railway wages. The gross earnings of the railways are derived from freight, passenger and express rates paid by the public, and are the only source from which wages can be paid to their employees. Railway gross earnings in 1935 were 4 per cent smaller than in 1916 —$3,597,000,000 in 1916, and $3,450,500,000 in 1935. In 1916 the average number of hours worked per employee was 3,151, for which average annual compensation was $891.61, or 28.3 cents an hour. Since April 1, 1935, the average hourly wage has been 69.2 cents, and the 3½ per cent tax upon pay rolls added by recent legislation increases it to the equivalent of 71.6 cents an hour. In 1934, the latest year for which the figure is available, average hours worked per employee were 2,376. On the basis of this number of hours and of compensation (including the new tax) at 71.6 cents an hour, average annual compensation per employee would be $1,701. This would give the average employee $809 a year, or 90 per cent, more compensation than he received in 1916 for working 25 per cent, or 775 less hours.

The labor leaders have pending in Congress proposed legislation to require the railways to pay in future the same amount for 6 hours that they now pay for 8 hours. This would increase the average hourly wage to 92 cents an hour and, with the pay roll tax added, to 95 cents. If, in spite of the assumed reduction from 8 to 6 hours, employees actually continued to work as many hours as in 1934, this would give them an average annual compensation of $2,257, or $1,365 more than in 1916—153 per cent more pay for 25 per cent less hours. If working hours actually were reduced one-fourth they would be 1,784, and average annual compensation at 95 cents an hour would be $1,695. The average employee would then receive 79 per cent, or $703, more annually than in 1916 for working 43 per cent, or 1,366 less hours.

Effects of High Railway Wages

Let us see now what were the effects upon the total payroll and the number of employees of the changes in hourly wages and working hours between 1916 and 1935. Total wages paid in 1935 were about $210,000,000 greater than in 1916. The basic working day in 1916 was 10 hours and in 1935 was 8 hours. It was argued twenty years ago, as now, that a reduction of working hours would increase the number of employees. The number in 1916, however, was 1,647,097, and in 1935 only 994,079, a reduction of 653,018. The reduction of working hours and the advances in average hourly and annual compensation were of benefit to those who were employed in 1935. But how about these hundreds of thousands who were unemployed? It is claimed that reductions of labor's hours of work and advances in its wages will correspondingly increase its purchasing power. But in spite of the great increase in the average hourly wage, the total railway payroll in 1935 was only 14 per cent larger in 1935 than in 1916; and the total payroll is the real measure of the purchasing power derived from wages.

Others besides railway employees were affected by the changes in their working hours and wages. The railways are large purchasers of manufactures and fuel. The more of their earnings they have to pay out in wages, the less of them they can spend for manu-

factures and fuel. Their gross earnings being smaller and their payroll larger in 1935 than in 1916, they spent much less for manufactures and fuel, and consequently gave correspondingly reduced employment in manufactures and mining.

Their net operating income was about 50 per cent less in 1935 than in 1916. In consequence, they paid much smaller dividends, which reduced the purchasing power of the owners of their stock. Their average freight rate in 1916 was only 7.1 mills, whereas in 1935 it was 9.88 mills, or 39 per cent higher. All who had to pay this increase in the average freight rate, which was necessary because of higher wages, had their purchasing power thereby reduced. In other words, while less than 1,000,000 railway employees benefited in 1935 by the advance in the average hourly wage, it was paid for in unemployment by some 650,000 former railway employees and by hundreds of thousands of former employees in manufacturing and mining companies; by railway stockholders in greatly reduced dividends, and by the entire population of the country in higher freight rates.

High Wages in Other Industries, Also

The foregoing comparisons—or contrasts—between 1916 and 1935 have been made because the gross earnings derived by the railways from the public, and available to be paid out by them, were approximately the same in the two years. Let us now make a comparison —or contrast—between certain facts for 1929 and 1935. The national income in 1929 was $81,000,000,000, and in 1935 about $50,000,000,000, a decline of 38 per cent. The railways had 994,079 employees in 1935 and their average annual compensation was $1,653, or about 5 per cent less than in 1929 because they worked less hours. In other words, the population as a whole, out of an income reduced 38 per cent, had to pay the average railway employee almost as much income as he received in 1929.

But the railways are not the only industry in which wages have been greatly advanced since before the war. The National Industrial Conference Board recently published data indicating that between 1914 and November, 1935, the average hourly wage in the manufacturing industry increased 144 per cent, while production per man-hour increased only 127 per cent. This increase in average hourly wage was relatively about the same as in the railroad industry; in both manufacturing and railroading average hourly wages are now as high as in 1929; and in the railway as in the manufacturing industry the increase in the average hourly wage since before the war has been greatly in excess of the increase in output per man hour.

Now, upon what ground can it justifiably be contended that, when the total income of the entire population of the country is still 35 to 40 per cent less than in 1929, hourly wages in transportation, manufacturing and a few other large industries should be as high as in 1929, and 150 per cent or more higher than before the war? Working hours in these industries have been reduced; but the hourly wages in them determine their labor unit costs of production, and, therefore, the labor costs they must include in the prices and rates that purchasers of their products and services must pay.

An Issue Not Between Employees and Employers

The *Railway Age* contends that the current payment to railway employees of an average hourly wage which, including the pay-roll tax, is 153 per cent higher, or more than two and one-half times as large, as in 1916, constitutes exploitation of all the rest of the population of the United States; and we also contend that there could not be a more palpable attempt to increase this exploitation than that being made by railway labor leaders to secure legislation which would increase the average railway wage to 95 cents an hour. But excessive railway wages do not constitute exploitation any more than excessive wages in manufactures, or mining, or construction.

Furthermore, it would be impracticable substantially to reduce railway wages as long as correspondingly high wages are paid in the manufacturing, mining, construction and other industries. If railway wages were submitted to arbitration under the Railway Labor Act, they would be compared with wages in these other industries, and probably no award for their reduction could be secured unless it were shown that they were relatively higher than in these other industries.

Plainly, the issue presented is not merely between what is called "labor," on the one hand, and employers, on the other hand. It is one between those who are employed in certain industries, on the one hand, and a large majority of the working population, on the other hand. About 40 per cent of the population is dependent for its income upon the industries in which wages are high, and about 40 per cent lives on farms and in towns of less than 2,500 population. The remaining 20 per cent consists principally of professional workers and their employees, storekeepers and their employees and domestic servants in communities of 2,500 or more.

The average income of farm families in 1929 was about $1,240, and of urban families about $3,226. This disparity was principally due to the fact that the wages of employees in industry largely exceeded the incomes of farmers; and the lack of balance that it shows existed probably was the principal cause of the depression. Nothing lasting has been done to correct this lack of balance. There has been an increase in farm incomes due to drouths and AAA, but there also has been an increase in hourly wages in industry due to NRA and to the restoration of railway wages to a higher than pre-depression level.

"Political Wages"—What Shall Be Done About Them?

Present wages on the railways and in industry are "political wages," established largely owing to pressure from Washington. No politician, New Dealer or Old Dealer, will even mention them unless to laud them.

Nevertheless, they present an economic problem of the first magnitude. It is highly significant that the higher wages have been in any industry during the depression the greater relatively has been the unemployment in it. They have been the highest in the building industry, and there has been and continues to be relatively the most unemployment in that industry.

If wages in transportation and industry are relatively higher than the incomes of a great majority of those who buy transportation and the products of industry, this necessarily limits the amount of transportation and of the products of industry that can be sold, and causes continuance of unemployment in transportation and industry. Those responsible for the policies of the labor unions cannot be expected to admit any relationship of cause and effect between present wages and present unemployment. Politicians likewise will close their eyes to it. More intelligence and courage should be expected from leaders in transportation and industry. While general business is improving, the total improvement in it that has occurred actually has been relatively small, and it is still far from good. Prosperity will never be fully restored as long as the supposed business leaders of the country refuse to recognize, face and attack the problems that must be solved in order to restore it.

President Roosevelt's Letter

President Roosevelt's letter of March 8 to the railroads and the railroad labor executives reads very much like the speeches and other admonitory utterances of the Federal Co-ordinator of Transportation. There is little in it to which anyone honestly and intelligently interested in the railroads can take serious exception; and a very great deal which shows penetrating insight into the true nature of railroad difficulties.

The warning against fixing railroad working conditions by statute rather than by negotiation, for which ample machinery is provided under the law, is particularly timely in view of the "full" crew bill, the train limit bill, the six-hour day bill and other such legislation now pending in Congress. At the same time it is more than a little difficult to reconcile the fact that the hand that penned the March 8 *caveat* is the same one which has signed two pension bills which are the very epitome of legislative invasion of the proper field of union-management negotiation.

The negotiations now in progress between the managements and the railroad labor organizations, as we understand it, embrace only the protection of employees who might lose their jobs by reason of "co-ordination" projects. But the President's letter shows that he sees the problem of waste in railroading as it actually is, namely, as covering a much wider field than mere "co-ordination." Two extracts from his letter show this very clearly:

> In the long run the employees will surely gain from maximum efficiency and economy in railroad operation. With competitive conditions what they now are and promise to become, this is the only path to the increased traffic and revenues which the railroad future will require. . . .
>
> The employees ought not to forget what they will gain if the railroads can progress as transportation agencies and what they will lose if the railroads retrogress. . . .

Anyone who knows railroads knows also that the waste which is holding the railroads back in meeting competition is not restricted to unnecessary duplication of services and facilities, which "co-ordination" would eliminate. A principal source of the railways' difficulties in meeting competition are the outworn and unjustifiable working rules and the mileage basis of pay in train and engine service. The pay for hours not worked as a result of these antiquated rules, and a "horse and buggy" ratio of miles to hours is a colossal handicap to the railroads. It is proposed to furlough in "co-ordination" projects employees who are working eight hours a day for their money, yet no one apparently raises any question about those who used to work eight hours, but now in some cases are earning a day's pay in two or three hours.

One of the crying needs of the railroads in meeting competition of motor vehicles which carry only a few passengers or a few tons of freight, and require but one or two employees, is a similar rail vehicle which will handle traffic cheaply in retail lots. But you cannot do a retail transportation business on rails if you have to have three or four or five men on each vehicle. And you cannot compete with bus and truck drivers who do 200 miles in their eight hours with railroad employees who get two days' pay for similar time and similar mileage.

We heartily subscribe to the principles of union-management negotiation, rather than legislation, to bring the railroad industry up to the efficiency it must have if it is to prosper in an era of intense competition and afford an expanding field of profitable and secure employment to railroad labor. But the problem is not one merely of combining a few terminals. It involves nothing less than a stock taking of the entire industry. The railroads can afford to pay good wages for necessary work. But with so much maintenance and improvement needing to be done, they cannot afford to pay a cent for idleness. The industry needs to be rehabilitated and revivified. Every man paid to ride a train who has no indispensable duty to perform is preventing the employment of a trackman or a shopman or a traffic solicitor who would help put the industry back on its feet. Every hour paid for but not worked is depriving men of employment who would for the same money do work which would improve the safety, speed or economy of railroad service.

Savings by Weight Reduction and Streamlining*

A critical analysis of the economics involved and the savings that can be effected thereby

By L. K. Sillcox
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IT IS sometimes argued that railway rolling stock and motive power, as built to meet present-day traffic requirements, are too heavy in proportion to their capacity, the contention being that lighter materials should be used or resort had to welded instead of bolted and riveted connections. The haulage of unnecessary weight naturally entails waste of energy and is reflected in the fuel bill, while the passage of heavily loaded wheels affects the cost of maintaining permanent way and all track structures. The term "unnecessary" itself gives rise to further argument, for there are definite limits below which it is inadvisable, if not actually unsafe, to go in the construction of modern locomotives and cars. It can be shown that much can yet be done towards reducing weight without taking any such risk or interfering with stability and satisfactory operating characteristics. Higher grade steels, for instance, make possible a reduction in weight of frame and motion details and boiler plates without sacrifice of strength. The same process combines lightness with rigidity in other phases of both locomotive and car construction. The matter is one which must, as a matter of course, respond to economic benefits which are calculable.

Weight Requirements for Adhesion

There is little opportunity for reducing the weight of locomotives since good use is made of all the weight carried on driving wheels to increase the drawbar pull which can be exerted without wheel slipping. Reciprocating parts must, however, be considered apart from the vast bulk of the steam locomotive. A four-wheel engine truck, bearing sufficient weight to make it an effective guiding unit, is essential in high-speed service; the driving wheels must bear a weight which, multiplied by the normal coefficient of adhesion, will provide the desired pull at the tender drawbar; the wide fireboxes of modern locomotives require the installation of wheels, smaller than any practicable driving-wheel diameter, for their support.

There is, then, no opportunity for weight economy without diminishing tractive capacity, except in the axle loading of the trailing truck, and the adhesive weight at this location is frequently utilized in starting by the installation of a trailing truck booster. Sometimes it is desired, in the interest of economy of operation, to increase the boiler pressure of a steam locomotive and maximum permissible rail loading prevents an increase of weight upon the driving wheels. Then special boiler materials can be used to advantage for weight reduction, together with the incidental advantages of corrosion resistance and attendant lower maintenance costs.

In car construction, however, there are no minimum weight requirements for adhesion and the effect of each pound of weight saved is reflected in a lower cost for movement of the car, while, in some cases, other important benefits accrue.

Cost of Hauling Dead Weight on Level Track

Practically, it matters little whether a train is comprised of 99 or 100 cars, in so far as the cost of its operation over a mile of track is concerned. It would be difficult to measure the increased fuel consumption which the extra car involves. That there must be a difference is certain. At 20 m.p.h. a car with a gross weight of 50 tons will offer approximately 240 lb. resistance on smooth, level and tangent track. In horsepower this represents:

$$\frac{240 \times 20}{375} = 12.8 \text{ hp.}$$

based upon the relationship

$$\text{Hp.} = \frac{R\ V}{375}$$

where

Hp = horsepower
R = resistance in pounds
V = speed in miles per hour

If the locomotive is delivering 2,000 hp., an increase in output of less than 1 per cent is involved. A modern steam locomotive will produce 12.8 drawbar horsepower hours at an expenditure of 30 gallons of water and no more than 40 lb. of coal. The water and coal consumption required to haul the single car one mile is then 12.5 lb. of water and 2 lb. of coal, representing a cost of a little less than ½ cent.

To accomplish a saving of this order by reducing car weight rather than by limiting the number of cars hauled would mean a reduction of 1,000 lb. per car, a ratio of approximately 2 per cent. An open-top freight car in coal service moves about 10,000 miles per year. At the above rate a saving of 1,000 lb. per car would result in an annual net economy, by requiring less locomotive fuel and water, of approximately 45 cents. With interest and depreciation at 10 per cent, this saving would justify an additional investment in the car of only $4.50 and a little less than ½ cent per pound could be paid for weight saved without incurring an actual loss.

The real economy of weight reduction is involved in a number of factors: First, cars move on level, tangent track a relatively small proportion of the total time that they are in service; second, many cars produce much more than 10,000 car miles per year; third, with standard journal sizes and capacity loading each increment of weight reduction will increase car capacity an equal amount, and, fourth, for a given speed and net capacity per train lighter and less costly motive power may be employed. With reference to item three above, an increase in car capacity will have an immediate effect upon

* Abstracted from a paper entitled "Advance Through Adversity" presented before the Engineering Institute of Canada, Hamilton, Ont., February 6, 1936.

car inventory and the number of trains required to handle a given net tonnage and, indirectly, upon locomotive inventory, train operating costs and yard expenses.

Variations of Resistance with Weight Changes on Grades

Opposing grades and curvature have an important influence in adding to the effect of dead weight of equipment upon motive-power requirements. If the grade is expressed in feet per hundred or as per cent, the resistance in pounds per ton will be $\frac{2{,}000}{100} = 20$ lb. per ton for each one per cent of grade. The resistance caused by curvature amounts to from 0.7 to 1 lb. per ton per degree of curvature, the lower figure being used with large capacity and the higher figure with small capacity or light-weight cars. A 6-deg. curve would, therefore, require an increase in tractive force of 4 to 6 lb. per ton. The variation of freight-car resistance with grade and car weight is shown in the table.

Variation, with Grade and Car Weight, in Resistance Offered by Freight-Train Cars

Weight of car, tons	Total resistance of car on various grades, lb.							
	Level	0.2 per cent	0.4 per cent	0.6 per cent	0.8 per cent	1.0 per cent	1.2 per cent	1.4 per cent
20	227	307	387	467	547	627	707	787
30	254	374	494	614	734	854	974	1,094
40	281	441	601	761	921	1,081	1,241	1,401
50	308	508	708	908	1,108	1,308	1,508	1,708
60	335	575	815	1,055	1,295	1,535	1,775	2,015
70	362	642	922	1,202	1,482	1,762	2,042	2,322

These results demonstrate the particular importance of car weight in heavy grade territory.

The annual mileage of railway car equipment varies widely with car type and service in which it operates. Hopper cars are successively subjected to delays at the mines, they move slowly in heavily loaded trains, and lie idle on sidings and in yards, while preference is given perishable merchandise and that which commands a higher rate. They are not unloaded promptly and the empty return movement is retarded in the same way. Box cars regularly operate a mileage 50 per cent greater than the average for hopper cars, while tank and refrigerator cars may produce several times the mileage of box cars, the actual mileage varying widely with the specific service and the state of the production of, and market for, the commodities which they carry. The highest annual mileage obtained from any car type is found, of course, in passenger service and, as schedules have been quickened in recent years, opportunity for even greater utilization of equipment, as measured in terms of distances covered, has been made possible without any reduction in the turning time at terminals.

Weight Reduction Increases Car Capacity

To reduce the weight of a 50-ton hopper car by 1,250 lb., its load limit on 5½-in. by 10-in. journals being 169,000 lb. and car weight 44,000 lb., will increase the net capacity 10 per cent without exceeding journal capacity. This would reduce the number of cars required for the movement of a given net tonnage and, if trains were made up to utilize the full tonnage rating of the locomotives in every case, the number of trains would be reduced in proportion. Yard costs vary with the number of cars handled and so would be directly affected wherever these light-weight, open-top cars moved in great numbers. Opportunities for economies then extend beyond the fuel and water accounts to embrace crew wages, yard costs, car maintenance and all items associated with car-miles or train-miles.

One would naturally look first to equipment operated in passenger service to find the place in which light weight might be most profitably employed. There are other reasons for investigating passenger-train equipment in the light of modern developments in metallurgical and fabrication practices.

Railway patrons are accustomed to witness progressive advance in the new equipment offered by competitive carriers and the fact that the railways operate the same cars, year after year, has been responsible, in part at least, for the prevailing attitude that the railways have nothing more to offer, having reached their zenith in facilities and operating practices. More important still is the effect of speed upon power requirements and, further, the effect of power requirements upon the cost of the motive-power unit. If speed is to be greatly increased, the number of cars per train must be reduced and thus the earning power of the train is affected. The alternative is then to reduce train resistance and this can be done most effectively by weight reduction.

Roller bearings assist to some extent, but their contribution is relatively unimportant at high speeds of operation, the real advantages of roller bearings being the lower starting resistance which they offer and the reliability of their performance when properly installed. The streamlining of trains can be arranged to indicate a real saving as long as the train moves directly into the wind, but, with a strong beam or side wind, science has not yet shown the industry how to reduce appreciably the flange pressure and the eddy formation upon the leeward side without disturbing accommodations to the point that it would be impracticable to attempt to employ the suggested principles.

The first trains introduced upon this continent in anticipation of sustained speeds approaching 100 m.p.h. were of a radically novel and effective design. Nothing less would have satisfied the popular demand since a quite definite opinion had been formed as to just what appearance a high-speed train should present. A Diesel engine was selected for motive power since it could be hidden away inside the streamline body and there was no necessity for an outside driving mechanism, requiring ready accessibility for inspection, adjustment, lubrication and repair. The lower center of gravity obtainable was also desirable.

There can be no question as to the operating economy of the trains of this type. The installed power capacity is decidedly less than would have been required had less effort been made to reduce resistance to the practicable minimum consistent with passenger capacity. It is no more than one-third that of a steam locomotive of the type which would be placed at the head of a conventional passenger train offering the same accommodations. The cost data in the table have been offered by one railway which is operating a light-weight, articulated, Diesel-electric, three-car train, submitting actual recorded costs for comparison with equivalent cost items as they relate

Comparative Costs per Train-Mile Three-Car, Diesel-Electric vs. Five-Car Conventional Train with Steam Locomotive

Account	Diesel-electric	Steam
Maintenance		
Steam locomotive	.....	$0.1466
Diesel power plant	$0.0188	.....
Train	0.0356	0.0080
Fuel	0.0141	0.1190
Water	.....	0.0068
Lubricants	0.0108	0.0034
Crew wages	0.1709	0.2360
Train supplies and expenses	0.0311	0.0468
Terminal charges	0.0351	0.0375
Locomotive supplies	.....	0.0019
Enginehouse expense	.....	0.0263
Lounge car attendant	.....	0.0077
Total	$0.3164	$0.6400

to service with a five-car conventional train with steam locomotive.

Another railway administration, also operating a three-car train, presents a similar total cost per train-mile, but with a different apportionment among the several items which make up the total. For instance, power-plant and train maintenance, elements of expense for which probable values are yet very imperfectly known, are assigned at twice the values given above. Crew wages are the same, as is the cost of lubricants. Fuel expense is nearly twice the above figure, due—at least in part—to the territory in which this train operates.

One must not overlook the fact that fixed charges arising from the initial investment are not included in the total. This is for the reason that representative figures for interest, depreciation, taxes and insurance cannot be assigned. Since these items are independent of the mileage operated, any attempt to express fixed costs upon a mileage basis would be applicable only to the specific operation for which they were derived. Moreover, current depreciation rates for these new train types will undoubtedly be adjusted many times as experience is gained, presenting opportunity for authentic assignment.

A potential high annual mileage and an operating cost half that of an equivalent steam train is an attractive outlook, particularly when it is realized that the lower costs apply to a greatly accelerated service. Furthermore, a 64-cent cost is a very moderate figure for the operating expense of a five-car, conventional train. Here again, fixed charges are omitted since the alternative equipment, available for substitution in the service of the high-speed unit, is carried with a book value which is dependent upon the age and service of the equipment and the operating company's retirement policy.

Limitations of First Light-Weight Trains

The introduction of the new series of high-speed, streamline trains was heralded the length and breadth of the country and they were most enthusiastically received. That they offer new opportunities in speed at low cost is readily conceded. The ultimate public reaction to the limitation in space allowed cannot yet be determined, but there are many who remain of the opinion that the long-distance passenger will require more commodious quarters, both for day and night travel, if the trains are to receive repeated patronage and some later designs afford more space per passenger while adhering to the general design of the earlier constructions.

The experiences with articulated construction have proved its merit in relieving end shock due to interaction of coupled cars and the estimated reduced resistance of the smaller number of journals has been established, but the inflexibility in train consist will, it is quite certain, limit complete articulation to trains of short to moderate length. The Gulf, Mobile & Northern, by reason of the service which it was desired to operate, deviated from the precedent of articulated construction in order that the sleeping car, which was purchased to supplement the accommodations of either of the three-car trains, could be introduced and withdrawn at will, serving first in one and then in another train unit. The latest of the Union Pacific's streamliners, not yet on the rails, will comprise an independent power unit or locomotive, with twin-articulated car combinations, whereby any two articulated bodies can be switched from the train to adapt the train consist to the traffic offered and to permit withdrawal from service of a defective unit without interrupting the availability of the train as a whole.

The inauguration of new, substantially conventional, but entirely modern passenger train equipment, consisting of steam locomotive and trailing cars, could never have been as spectacular as was the initial service of the first streamline, oil-electric trains. The railways which first installed equipment of this type have benefitted greatly by the advertising value associated with the publicity which they received and the trains themselves have been well patronized. Future trains of this type will not be received with the same degree of interest and to that extent an important potential advantage, fully exploited by the administration which first saw the service possibilities of these trains upon their lines, will be lost. While new trains of this general type will attract local interest for some time to come, they must look to low operating costs and peculiar adaptability for their selection in preference to modern examples of steam locomotives and cars.

Whether installed within a power car which may also afford mail and baggage space, or mounted in a specially constructed chassis to constitute a locomotive, the oil-electric drive must remain much more costly than the same capacity in a steam locomotive. Maintenance facilities must be appropriate for its successful operation. The lack of such facilities and properly trained personnel has been responsible for the poor operating record of many a rail motor car or other special equipment type which has been entrusted to inexpert and perhaps unsympathetic hands. The economy of standardization in equipment types or maintenance operations has been repeatedly proved and, unless there are sound economic reasons for deviating from the practice, a confusion of machines, serviced by a single group, is unwarranted.

Whether new trains are to be articulated or comprised of independent units; whether cars be constructed of mild steel, high tensile steel, or light-weight alloys; whether they be hauled by a steam locomotive or propelled by an internal-combustion engine; one trend is established and has been accepted by the public to the extent that all new railway passenger equipment should be designed to afford at least a superficially streamlined appearance. The development of the railways' newest competitor, the airplane, is responsible for the public insistence upon faired contours. Acceptable design must always have regard to the appearance of fitness for the work to be accomplished and, since passenger transport has come to be regarded as the racing of men to their destinations with an unrelenting demand for faster schedules in all services, the equipment employed must present an appearance which indicates ability to satisfy the requirements. This fitness to the service in competition with other modes of transport may be evidenced by car side sheets which are extended below the side sills to conceal the under structure, flush windows proportioned to suggest length and sleekness in the car body, flush diaphragms, concealed steps, rounded top, or merely an artful combination of body coloring and trim. Whatever the public displays a disposition to accept as progressive and appropriate in the equipment which is presented for its use, the railways must provide and, when streamlining is demanded, the designers of railway equipment must adapt their plans to respect this urge—and to do so economically.

Practically, the streamlining of railway equipment, particularly of trains having a high ratio of length to cross-section, is of relatively little consequence and cannot be considered in the light of an important technical advance. There are yet few trains operating over long distances within a speed range which introduces air resistance in a measure warranting any considerable expense to effect its reduction. It is only at the advanced speed of 100 m.p.h. that air resistance represents as much as 45 per cent of the total resistance of a train

consisting of a steam locomotive and ten 150,000-lb. cars of conventional type, moving through still air. At 80 m.p.h., air resistance accounts for 36 per cent of the total, and at 60 m.p.h., approximately 25 per cent. At 60 m.p.h., the air resistance offered by an equivalent steam locomotive and train may be reduced approximately 36 per cent by adopting a streamlined locomotive together with well streamlined cars.

No railway vehicle has yet been constructed which complies in every detail with these specifications for ideal streamlining as they have been formulated to date. In fact, no operating vehicle, even the airplane and lighter than air craft, can ever assume the ultimate in streamlining for reasons of the practical utility which it must display. Accessibility of all parts which require frequent inspection or servicing is essential. High labor costs and such other conditions of railway operation as are met on our large systems make it impracticable to consider locomotive streamlining measures comparable with those employed by the German State Railways. The German scheme provides a continuous shroud to conceal the driving gear, with service openings along the sides which are covered when the locomotives are in service. Delays in completing repairs cannot be tolerated where labor charges dominate service charges. It is true that refinements are constantly introduced to meet such situations—the Commodore Vanderbilt on the New York Central is now fitted with roller bearings on all driving axles and at all rod connections, while a ton of weight has been removed from the revolving and reciprocating parts, factors which should appreciably reduce the maintenance attention required to keep the locomotive in service.

Just as experience and practical necessity have revealed the undesirable features of complete articulation and of minimum cross-section in car equipment, so they have shown that there may be no practical and compensating value in extending side sheets beneath the cars to cover all the irregularities of surface common to fabrication and attachment of auxiliaries. It is appreciated more and more that the governing factor in the recommendation of streamlining is the viewpoint of the prospective railway patron and any considerable expense incurred in an effort to reduce air resistance which does not, at the same time, attract public favor, will likely prove unjustified. If the construction of any unit of railway equipment yields as readily to streamlining as to angular treatment of the external outline, the choice of form is evident. When, however, appreciable expense is involved, streamlining by optical deception is the proper solution where it can be practiced.

Freight Car Loading

WASHINGTON, D. C.

REVENUE freight car loading for the week ended February 29 totaled 673,123 cars, an increase of 86,411 or 14.7 per cent above the preceding week, which included the Washington's birthday holiday, and an increase of 68,792 or 11.4 per cent above the corresponding week of 1935. All districts reported increases as compared with last year and loadings in all of the eight commodity classifications, except merchandise l.c.l. and live stock, were likewise above 1935. Loadings of coal and ore were slightly below those of the preceding week. The summary, as compiled by the Car Service Division of the Association of American Railroads, follows:

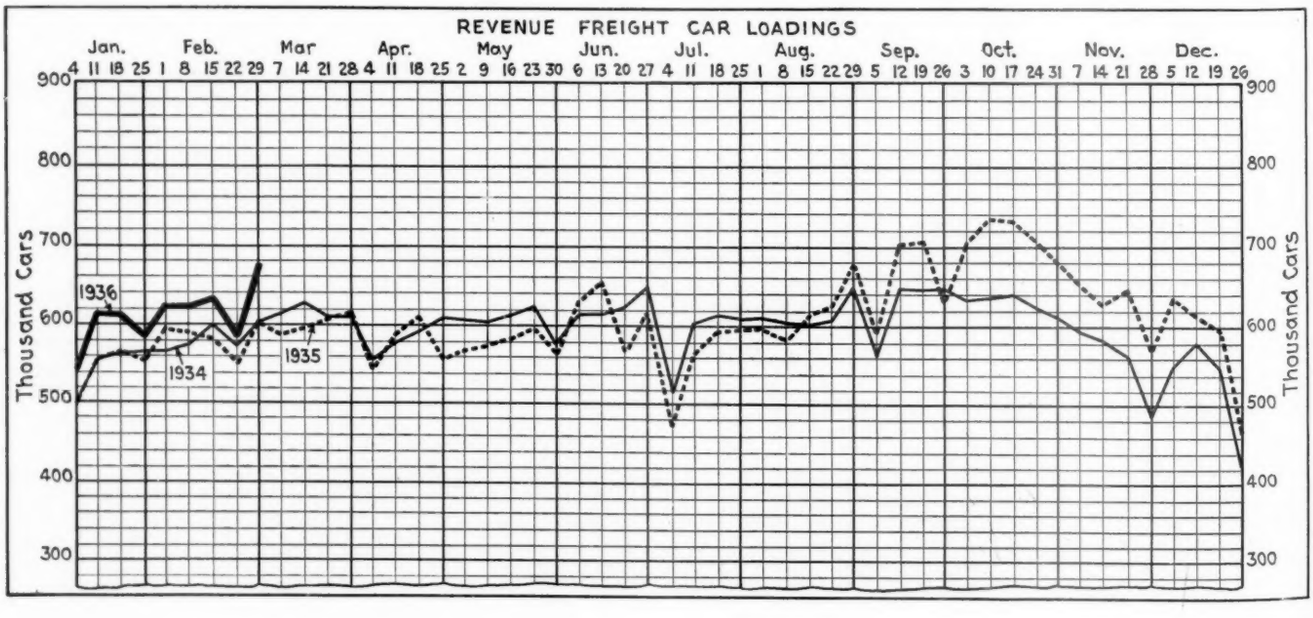
Revenue Freight Car Loading

For Week Ended Saturday, February 29

District	1936	1935	1934
Eastern	150,387	140,480	148,127
Allegheny	132,815	119,238	121,930
Pocahontas	53,149	45,460	43,249
Southern	101,797	94,756	90,601
Northwestern	79,653	68,676	69,787
Central Western	97,450	86,624	83,810
Southwestern	57,872	49,197	48,213
Total Western Districts	234,975	204,397	201,810
Total All Roads	673,123	604,331	605,717
Commodities			
Grain and Grain Products	36,677	29,125	29,107
Live Stock	10,573	12,731	14,031
Coal	175,153	138,849	158,976
Coke	10,313	8,236	10,791
Forest Products	29,866	26,010	21,576
Ore	5,874	4,191	2,646
Merchandise L.C.L.	157,947	159,708	162,459
Miscellaneous	246,720	225,481	206,131
February 29	673,123	604,331	605,717
February 22	586,712	553,165	574,908
February 15	631,347	581,669	600,268
February 8	622,097	591,327	573,898
February 1	621,839	596,961	565,401
Cumulative Total, 9 Weeks	5,488,229	5,096,599	5,103,273

The freight car surplus on February totaled 195,839 cars, a decrease of 35,567 cars as compared with Janu-

(*Continued on page 483*)



Railroads Not Out of Woods Yet

Eastman in two speeches decries labor opposition to economies, says managements give them "lip service"

FEDERAL CO-ORDINATOR JOSEPH B. EASTMAN in speeches before the Sioux City Chamber of Commerce on March 7 and the Chicago Traffic Club on March 9, gave expression to his views on several phases of the railroad problem, the principal theme of both addresses being the need for greater progress in collective economies by the railroads. Railroad managements were accused of approving such economies in principle, but with a tendency to give them "lip service" rather than to "get down to work" and put them into effect. Railroad employees, at the same time, were held up as short-sighted in their opposition to these projects because they might displace labor. "The welfare of these men is not a thing of the moment alone," he declared, "but a continuing problem which reaches into the days which are to come;" and the only future security for railroad jobs is an industry stripped clear of inefficient practices and needless duplication so that it may hold its own competitively.

In his Chicago address Mr. Eastman labeled his remarks "The Troubles of a Co-ordinator" and warned his audience that the discussion might be "a little dolorous like the editorials of the 'Traffic World,' not to mention the *'Railway Age.'*" Among other things he said:

We Are Not Yet on "Easy Street"

There seems to be a tendency to sing "Happy Days are Here Again," because there have of late been substantial gains in railroad traffic. While the joy is natural, and I do not want to dampen it, there are facts which ought not to be overlooked before one jumps to the conclusion that railroad troubles are over. A line of reasoning which is often heard is that in the adversity of depression the railroads have found possible, and have actually accomplished, so many economies that if traffic returns to the 1929, or even the 1930, level, they will be on Easy Street.

There are two things to be considered in this connection. One is that by no means all of these economies are permanent. Many are merely the reflection of decreased service which will have to be restored, if traffic increases to the level suggested. Some are the product of work done, which should have been done and must eventually be done. The other thing to bear in mind is that at the rates and fares which are now being charged, 1929 or 1930 traffic would by no means produce 1929 or 1930 revenues. This is a difficult thing to gage precisely, but I have seen figures indicating that if 1934 traffic had been carried at the rates and fares which prevailed in 1928, the revenues in 1934 would have been greater by more than $400,000,000.

Need for Economy Has Not Disappeared

The trend of railroad ton-mile and passenger-mile revenues has been downward, and you also know that this trend has not reached its end. What is happening with respect to passenger fares and store-door collection and delivery of merchandise traffic is sufficient evidence of that fact. Moreover, it would be a mistake for any one to assume that gains in economy and efficiency are confined to the railroads and that the other forms of transportation are standing, or will stand, still in this respect. As one illustration, buses have by all accounts done surprisingly well, notwithstanding the reduction in railroad fares, and even in the South, where the basic railroad fare has gone down to 1½ cents. It would also be a mistake to assume that improvements in service necessary to meet competition can be given without increases in cost. For example, stream-lined trains and air-conditioned cars are good, but they cost money.

Present gains in railroad traffic are in no way sound reasons for neglect of any feasible means of increasing the economy and efficiency of railroad operation and improving the quality of railroad service. The railroads have a long way to go before they are out of the woods and in a condition for effective conduct by private enterprise and private capital. I do not say that they will not reach this goal, but I do say that the path which they will find it necessary to take is the path of improved service and lower average rates, and that only maximum economy can make that path safe.

You know that I have certain convictions, which some think are obsessions, in regard to the amount of waste which now exists in railroad operations, and what can be done to avoid it through a policy of greater railroad co-operation anud co-ordination. Let me give you an illustration in your own home grounds. Recently, V. V. Boatner, my Director of Regional Co-ordination, submitted a report to the Western Regional Co-ordinating Committee of the carriers on the unification of railroad terminal facilities in the Chicago area. This report indicates that with a comparatively small capital expenditure a plan of co-ordination could be made effective which would have net as much as $10,000,000 per year, without allowing for possible compensation to displaced employees. With such compensation, the full economies would be deferred, although they would ultimately be realized. In principle, there is nothing novel about this plan. What is proposed is sound and feasible. There have been several prior reports, the first one dating back as far as 1908, and they all reached similar conclusions. Yet nothing has been done.

Without undertaking to say that the reports which my staff has issued are bullet-proof and sound in all particulars, I do say that they have shown that there is a large amount of waste in railroad operations which can be eliminated without any harm, and often with benefit, to service, and that many other improvements in service, equipment, and rates are possible which will more than pay their way. To my way of thinking, it is of profound importance to the future welfare of the railroads that many of these projects be pushed and carried into effect. What are the obstacles which stand in the way?

Eastman "Bombarded" by Railroad Employees

There is, first, a railroad labor obstacle which has assumed large proportions. Since proposing to issue orders requiring certain terminal unifications, I have been bombarded with protests coming, directly or indirectly, from the railroad employees. The burden of these protests is this: The country has been passing through a severe depression. Millions have been, and still are, unemployed. We have been trying to correct that situation and put men back to work. There are signs that the country is on the way out of the depression, and employment is on the increase. At such a time it is the height of unwisdom and contrary to sound public policy to force projects which will deprive railroad employees, who as a class have suffered acutely in the depression, of work and add to the number of unemployed. This argument is offered, not only by the employees themselves, but by many men holding public office, and in some cases by commercial organizations in the towns affected.

That the argument has a strong appeal goes without saying. The employees have a vital interest, and their welfare ought to be given every consideration. Nothing on earth is more important than to give people the opportunity to work and make a decent living in useful occupations. Our political and industrial systems are rank failures if they cannot achieve this result. But in this particular situation which I am now discussing, we shall be guilty of grave error if we allow sympathy for the

railroad employees to blind our eyes to the future and focus out attention on the immediate present. The welfare of these men is not a thing of the moment alone, but a continuing problem which reaches into the days which are to come.

Railroad Costs Must Come Down

Gone are the old days when the railroads could be sure that whatever property and people there were to carry would mostly have to be carried by them. Water carriers, highway motor carriers, air carriers, and pipe lines, to say nothing of electric transmission lines, are big and growing factors in the situation and must be reckoned with. They are demanding and receiving their shares of the traffic offered, and the trend in quality and quantity of service is upward, while the trend of unit revenues from the service is downward. I look forward to a live and growing railroad industry with continually increasing traffic, revenues, and employment, and I believe such a railroad industry is possible. But I do not believe that it is possible unless railroad costs are reduced in every practicable and feasible way and the reductions utilized as the means of adjusting service, equipment, and rates to the new transportation conditions which are here, which will continue to develop, and which must be met.

Considering only the welfare of the railroad employees and nothing else, now that we are emerging from the low depths of the depression and business is on the increase, my conviction is that the time has come to set the railroad house in order and take every practical step in the direction of maximum efficiency and economy in operation. From the standpoint of the employees, the right time to make such changes is when traffic is on the rise, and new business will permit the absorption, rapid or gradual, of those who are displaced.

I would go further than that. For the sake of good morale and inherent justice, the railroad managements can well afford to offer a reasonable measure of protection and compensation, graded with age and length of service, to those who may be temporarily displaced. I realize that this is a principle which most industries do not now apply, and it is not even applied by our own government. But it is a sound principle, where the funds are available from the savings realized; it is gaining rapidly in recognition, both here and abroad; and it is, after all, only a logical extension of the pension principle, which is very generally recognized and accepted.

Why Railroads Do Not "Co-ordinate"

The other big obstacle is the attitude of the railroad managements themselves. There is no better example than the one right here. For 28 years the carriers have withstood a barrage of reports on the Chicago terminal situation, all reaching much the same conclusions, and nothing has been done. I think the reason is fear. One line fears that it may lose some strategic advantage with respect to New York-Chicago passenger traffic. Another has an exceptionally favorable rental arrangement for the use of some station and fears that it will have to sacrifice this advantage. Others think that they have virtual command of certain traffic of certain industries, and fear that other railroads will be given better access to this traffic than they now have. These fears of possible disadvantages which may result here and there from a plan of terminal co-ordination are allowed to obscure the vision of the greater advantages which the plan holds forth. It is an illustration of a common trait of human nature. Most people will fight much harder to keep a little thing which they have and which they value than to get a bigger thing of much more value which they have not.

Inter-railroad Competition Has Not Helped the Farmer

The subject of the Sioux City address was "Agriculture and Transportation," but in it Mr. Eastman covered much the same ground with reference to the desirability of co-ordination economies, but in less detail. He also explained the workings of the Motor Carrier Act. But some of his discussion at Sioux City covered still different subject matter, and among this was the following:

Among the numerous anomalies which I have noted in the 17 years which I have spent on the Commission is the fact that many holders of railroad securities sincerely believe that they have been betrayed by the Commission because of political pressure from the farmers, whereas many farmers sincerely believe that the Commission has oppressed them in the interests of the railroads and "Wall Street."

One of the reasons, no doubt, why freight rates have always been such an issue in the granger States is the fact that the competition of the railroads with each other has had very little influence on the rates from the farms to the primary markets. Such competition gets in its work when big producers of traffic located at strategic points have a choice of railroad routes in moving their commodities to market. Those were the shippers who in the old days were given rebates. I doubt whether farmers ever received any such concessions, and certainly not the farmers in this midwestern territory. In the movement of grain from the primary markets and of grain products from the mills, railroad competition has played an important part and has resulted, as in the case of transit privileges, in various abuses which do neither the railroads nor the farmers any good; but such influences have seldom affected the initial movement of products from the farms.

Popularity of Trucks with Farmers

Every day transportation is becoming more complex, and we have got by the time when we could think of it in terms of railroads alone, or even of railroads and water lines. A huge new transportation industry has sprung up, in the carriage of persons and property by motor vehicle over paved highways, and in an extraordinarily short space of time it has grown out of infancy into vigorous manhood. It has become a big factor in the transportation of farm products, not as yet of grain, but certainly of livestock, dairy products, and fruits and vegetables, to say nothing of the movement of inbound materials and supplies to the farms. The farmer has gained many benefits from this new form of transportation, and it is quite evident that he sets great store by it—and rightly so. In this Sioux City area you have an exceptional interest in these developments, because I understand that truck movements of livestock into this market are among the most extensive that exist anywhere in the United States.

It is necessary in appraising the benefits of any new means of transportation to take into account all the facts, including those which do not appear on the surface and require investigation. When, for example, the government bears a considerable part of the cost, as in the case of highways and waterways, that part, which may burden shippers in ways which are not readily apparent, ought not to be overlooked in determining actual economy or lack of economy. Nor ought such a thing to be overlooked as the effect which a new means of transportation and distribution, unless brought under proper control, may have on the maintenance of adequate and stable market prices for farm products.

Railroads Still Necessary to Farmers

But important as motor carriage is, it does not, in my opinion, present the greatest problem which we are now facing in transportation. The railroads still rank as the chief means of transporting property in this country, far in the lead of any other means, and that there is no great likelihood that they will be displaced from this position for a long time to come. They are, therefore, a very appropriate subject of concern for all who are dependent upon transportation, and certainly for the farmers. I think you will agree that, convenient as the trucks often are, the railroads are still the mainstay in a great part of the transportation of farm products.

And yet, although the railroads retain first rank, they have been greatly affected by the recent extraordinary development of competing forms of transportation, and they will continue to be affected in increasing degree, in view of the rapid growth in the efficiency of their competitors which can confidently be predicted. The conditions surrounding railroad operation are very different from what they used to be. Railroad methods of operation, service, equipment, and rates must inevitably be changed in many ways to meet the new conditions.

Changes of this character have already begun, and sooner or later, and in one way or another, all that are necessary will be made. The danger is that they will not be made as soon as they should be; that the railroads will fail to hold, to say nothing of creating, much traffic which they are potentially best fitted to handle; that they will not be able to give the service which the public has a right to expect; and that they will at length drift

into, or fail to extricate themselves from, a condition which can be remedied only by radical measures that may tax the resources of the country.

Lower Rates Needed as Well as Better Service

We have a continuing and pressing railroad need for better service and lower rates reinforced, so far as agricultural products are concerned, by a like need which the farmer feels, and for a long time has felt, very keenly. The question is how to satisfy these needs. In other words, how can the railroads give better service at less cost? So far as better service is concerned, there are many possibilities, in the way of improved motive power, equipment, and facilities, which are developing very rapidly and promise to be of great importance; and some of these improvements will also reduce expense. The trouble is that it takes money to get such new facilities, and poverty-stricken railroads lack the necessary credit. That brings us to the cost of operating the present properties. If that cost can be cut materially, it will either pave the way directly for improvements in service and reductions in rates or do this indirectly by making it easier to buy new and improved motive power, equipment, and facilities. Obviously, it is of the very first importance to attack this matter of present expense.

President Asks Agreement on Protection for Labor

WASHINGTON, D. C.

EXPRESSING his concern over the apparent inability of railroad managements and labor organizations to co-operate in working out common problems, and the fact that "issues which ought to be settled by friendly negotiation are being fought out in the battle grounds of Congress and the courts," President Roosevelt has called upon the railroads and labor to spare no effort to bring about a reasonable plan for protecting railroad employees displaced by economy projects by agreement rather than by legislation and litigation.

In a letter addressed to J. J. Pelley, president of the Association of American Railroads and J. A. Phillips, vice-chairman of the Railway Labor Executives' Association, given out at the White House last Sunday, he suggested that before the railroads and labor permit such an effort to fail, they confer jointly with him.

Committees representing the railroad managements and the labor organizations had been conferring on the subject for several weeks but had made little or no progress and last week the labor organizations had brought forward a bill which was introduced in Congress by Senator Wheeler and Representative Crosser, designed to substitute drastic restrictions on reduction in railroad employment for the temporary provisions of Section 7 (b) of the emergency transportation act which expires on June 16.

Attitude on Continuance of Co-ordinator Not Indicated

No indication was given as to the President's attitude toward a continuation of the co-ordinator's office beyond June 16 but he pointed out that the present protection of the law is now satisfactory neither to the companies nor to the employees. The President showed that he agreed with Mr. Eastman's position that there is much waste in railroad operation that can be avoided by consolidation or by greater co-operation and co-ordinated use of various facilities and that in the long run the employees will gain from such a policy, but he recognized that the employees are fairly entitled to protection against the temporary hardships which may be caused by sudden steps in this direction and said that in view of the proposed negotiations the co-ordinator had consented to defer for a time his proposed orders for the unification of terminals in 11 cities.

At the request of the labor committees Mr. Eastman had already agreed to postpone his orders for 30 days, or until the end of this month but they had asked for 90 days, which would bring them about the time of the expiration of the emergency act.

The President recognized that the principle of protecting employees against undue hardship from economy projects "is only beginning to gain ground" and that the railroad industry "cannot safely get too far in advance of the procession." Therefore he apparently has in mind some compromise which would be far less drastic than the proposals of the railroad labor organizations. He also had in mind the experience thus far of the efforts of the railroad labor organizations to provide new employment through a retirement law which they wrote themselves with more concern for what they wanted than for the requirements of the Constitution.

The President's letter follows:

The President's Letter

I am concerned by conditions in the railroad industry. With all the other means of transportation which have become so important and are developing so rapidly, the future of the railroads depends on sustained ability to improve service and, in many cases, reduce rates. Much new equipment is and will be needed. Not all that should be done can be done at once, but if the railroads do not progress, they will retrogress. The opportunities for progress are great and will expand. The danger is that these opportunities will be lost.

The country has a vital interest in this matter, but no one has a greater stake than those who own and those who work for the railroads. In many ways their interests are identical, and they ought to be able to work together for a common end. Certainly this is true of better and less costly service which will enable the railroads to lead, or at least keep up with, transportation progress. What disturbs me is the apparent inability of the managements and the men to co-operate in working out such common problems. Issues which ought to be settled by friendly negotiations are being fought out in the battle grounds of Congress and the courts. Legislation has its place. Often it has been necessary for the welfare of labor or capital or both, but it is a remedy to be taken with great caution or it may prove worse than the disease.

A critical situation prompts this letter. It is common knowledge that there is much waste in railroad operation, caused by the great number of railroad companies, and that much of it can be avoided, either by consolidations or by greater co-operation and co-ordinated use of various facilities. This waste hampers railroad progress and is a burden on the rate-paying public. It ought to be eliminated for the good of all concerned, and conditions favorable to its elimination are now developing. I say this because the tide of traffic is rising. Under such conditions unnecessary and wasteful work can be avoided with least hardship to employees, because new work comes in to take the place of much that goes.

In the long run, the employees will surely gain from maximum efficiency and economy in railroad operation. With competitive conditions what they now are and promise to become, this is the only path to the increased traffic and revenues which the railroad future will require. But sudden steps in this direction may cause temporary hardships. The employees are fairly entitled to protection against such hardships.

The Emergency Railroad Transportation Act, 1933, undertook to promote the elimination of railroad waste and at the same time protect the employees. This protection is now satisfactory neither to the companies nor to the employees, and by the terms of the Act it will, unless extended, terminate on June sixteenth, next. It is a matter which is capable of being settled to better advantage by negotiation than by legislation. Given sufficient time, the managements and the men ought to be able to agree, in their common interests, upon a reasonable plan of protection.

If they do not agree and legislation is sought as the only solution, I fear harm to the railroad industry. Both sides will take extreme positions. The effect of such legislation may be to discourage and prevent progress. Litigation will ensue. The courts may strike down what is attempted, so that the battle ground will again shift to Congress. The relations between the managements and the men will be embittered, with unfortunate results in many different ways.

All this can be avoided if the contending parties will confer

with each other in a spirit of reasonableness and moderation. The employees ought not to forget what they will gain if the railroads can progress as transportation agencies and what they will lose if the railroads retrogress. They ought to bear in mind that the principle of protecting employees against undue hardship from economy projects is only beginning to gain ground. It is not as yet applied by most industries, nor by the other transportation agencies, nor even by the government. The railroad industry has always taken the lead in the establishment of good working conditions and labor relations, but it cannot safely get too far in advance of the procession. Nor ought the employees to overlook the fact that if unnecessary railroad costs are not avoided, much desirable work that creates employment may not be undertaken. This has happened in maintenance work especially, and may easily happen again.

On the other hand, the managements ought to bear in mind that the principle of employee protection is steadily finding acceptance among responsible employers. It has been applied on the British railways and utilities. It has been voluntarily applied by certain large industries in this country, including several railroad companies. It is sound and right, and leading railroad executives have so stated. The railroads and their owners have much to hope for employee good will and morale if an amicable adjustment of this matter can be reached. They have even more to hope if they are able to develop among themselves the capacity for collective action and a willingness to subordinate pronounced individual views in the interest of effective co-operation.

Convinced, as I am, of the great benefits which will accrue to the railroad industry, to its employees, and to the country if this matter can be adjusted satisfactorily to both parties, I address you, as representatives, respectively, of the managements and the men, to express the hope that no effort will be spared on either side to reach such an adjustment. May I suggest that before you permit such an effort to fail, you confer jointly with me?

The Federal Co-ordinator of Transportation, acting under the mandate of the Emergency Railroad Transportation Act, 1933, is proposing certain orders directed toward the unification of railroad terminal facilities. As above stated, the protection to railroad employees which that Act affords is now satisfactory neither to the managements nor to the men. In view of the proposed negotiations, I have asked the Co-ordinator, and he has consented, to defer these proposed orders for a time.

Ex Parte 115 Hearings

WASHINGTON, D. C.

THE Interstate Commerce Commission on March 11 overruled motions for dismissal of the railroads' petition for continuation beyond the June 30 expiration date of the Ex Parte 115 emergency freight charges. Oral arguments on the dismissal motions were heard on the previous day. The commission is now expected to announce a schedule of further hearings, both in Washington and at other points.

The railroads completed presentation of their testimony on March 7, after which representatives of water carriers presented evidence in support of the petition. On March 9 there appeared several witnesses representing chambers of commerce and shipper organizations, including Louis C. Madeira, III, executive director of the Anthracite Institute, who presented data designed to show that coal is losing out in competition with other fuels. He referred also to the stolen-coal "racket," contending that there are 20,000 persons now engaged in stealing and marketing anthracite by truck. The annual traffic in this connection he estimated at three to four million tons, on which railroads are losing $6,500,000 a year.

Some of the chamber of commerce representatives stated their position as being one in opposition to making surcharges a permanent feature of the rate structure rather than of opposition to the carriers obtaining the additional revenue involved. These would not object to a short-term extension—for about six months.

The hearings are being conducted by Commissioner Clyde B. Aitchison, who has several state commissioners sitting with him.

1935 Net Deficit $287,538

WASHINGTON, D. C.

CLASS I railroads of the United States reported for 1935 a net deficit of $287,538, as compared with a net deficit of $29,438,445 in 1934, according to the Interstate Commerce Commission's compilation of select-

Selected Income and Balance-Sheet Items of Class I Steam Railways

Compiled from 143 Reports (Form IBS) Representing 149 Steam Railways

For the month of Dec. 1935	For the month of Dec. 1934	*Income Items*	For the twelve months of 1935	For the twelve months of 1934
$46,038,508	$39,225,995	1. Net railway operating income	$500,054,249	$465,688,606
*35,111,624	29,034,854	2. Other income	* 175,037,521	184,851,813
81,150,132	68,260,849	3. Total income	675,091,770	650,540,419
3,177,436	1,809,329	4. Miscellaneous deductions from income	18,953,800	20,311,865
77,972,696	66,451,520	5. Income available for fixed charges	656,137,970	630,228,554
		6. Fixed charges:		
11,523,122	10,965,359	6-01. Rent for leased roads	134,292,009	133,653,467
42,759,447	44,552,627	6-02. Interest deductions	507,406,253	511,005,629
228,671	320,556	6-03. Other deductions	2,691,778	2,986,429
54,511,240	55,838,542	6-04. Total fixed charges	644,390,040	647,645,525
23,461,456	10,612,978	7. Income after fixed charges	11,747,930	§ 17,416,971
1,012,003	998,729	8. Contingent charges	12,035,468	12,021,474
22,449,453	9,614,249	9. Net income †	§ 287,538	‡§29,438,445
15,625,400	14,800,720	10. Depreciation and retirements	194,132,884	186,259,223
1,760,909	§ 9,913	11. Federal income taxes	19,045,125	14,495,953
		12. Dividend appropriations:		
*23,222,552	32,210,299	12-01. On common stock	*108,552,201	115,255,772
3,855,180	3,635,197	12-02. On preferred stock	17,956,113	18,163,125

Selected Asset Items	Balance at end of December 1935	Balance at end of December 1934
13. Investments in stocks, bonds, etc., other than those of affiliated companies (Total, Account 707)	$734,005,310	$807,356,717
14. Cash	408,467,860	336,339,751
15. Demand loans and deposits	4,716,467	12,518,972
16. Time drafts and deposits	26,044,585	32,280,938
17. Special deposits	81,506,998	69,446,869
18. Loans and bills receivable	2,866,007	5,639,093
19. Traffic and car-service balances receivable	59,880,494	53,175,305
20. Net balance receivable from agents and conductors	43,048,852	40,978,487
21. Miscellaneous accounts receivable	138,357,388	149,999,190
22. Materials and supplies	279,926,886	297,681,057
23. Interest and dividends receivable	30,132,095	45,798,978
24. Rents receivable	2,195,505	2,845,316
25. Other current assets	5,486,300	10,529,664
26. Total current assets (items 14 to 25)	$1,082,629,437	$1,057,233,620
Selected Liability Items		
27. Funded debt maturing within 6 months¶	$330,941,204	$223,105,168
28. Loans and bills payable‖	313,741,127	318,953,438
29. Traffic and car-service balances payable	75,235,879	67,550,708
30. Audited accounts and wages payable	213,340,386	197,418,962
31. Miscellaneous accounts payable	64,327,238	80,682,793
32. Interest matured unpaid	442,775,359	337,914,006
33. Dividends matured unpaid	13,747,520	14,155,277
34. Funded debt matured unpaid	369,602,470	272,686,973
35. Unmatured dividends declared	9,266,521	8,402,871
36. Unmatured interest accrued	90,790,138	93,014,454
37. Unmatured rents accrued	24,681,710	23,609,208
38. Other current liabilities	20,479,133	27,049,974
39. Total current liabilities (items 28 to 38)	$1,637,987,481	$1,441,438,664
40. Tax liability (Account 771):		
40-01. U. S. Government taxes	36,113,699	32,595,255
40-02. Other than U. S. Government taxes	121,346,569	124,711,103

* Excludes $62,527,087, representing a dividend distribution of securities from the Oregon Short Line Railroad Company to the Union Pacific Railroad Company—an intra-system transaction.

† The net income for the month of December and the twelve months ended with December 1935 was reduced by $5,277,177 charged to operating expenses by the Illinois Central R. R. and the Yazoo & Mississippi Valley R. R. on account of equipment repairs made in 1934. Reversal of charges previously made for liability under the Railroad Retirement Act of 1934, increased the net income for December 1935 by $351,860 and for the twelve months ended with December 1935 by $8,414,271. For December 1934 the reported net income includes charges because of the Railroad Retirement Act of 1934 amounting to $981,423 and for the twelve months ended with December 1934 the charges included are $11,315,128.

‡ This figure differs from the net income shown in Statement No. 33 in the Statistics of Railways for 1934 due principally to the elimination of intra-system dividends. Figures for 1934 and 1935 are comparable in this statement.

§ Deficit or other reverse items.

¶ Includes payments which will become due on account of principal of long-term debt (other than that in Account 764, Funded debt matured unpaid) within six months after close of month of report.

‖ Includes obligations which mature not more than 2 years after date of issue.

ed income and balance-sheet items. The net railway operating income last year was $500,054,249, as compared with $465,688,606 in 1934. Fixed charges were down from $647,645,525 in 1934 to $644,390,040 in 1935 while last year's income after fixed charges was $11,747,930 as compared with a 1934 deficit after fixed charges of $17,416,971. The contingent charges increased slightly in 1935.

Dividend declarations last year totaled $126,508,314, as compared with $133,418,897 in 1934. Total current assets at the close of the year were $1,082,629,437, including $408,467,860 in cash, while total current liabilities were $1,637,987,481.

Seventy-nine of the 143 Class I roads whose reports are included in the compilation had net deficits last year. The commission's summary and the principal items for the individual roads are shown in the accompanying tables.

Selected Income Items by Regions and Districts, Class I Steam Railways, Calendar Years 1935 and 1934

Region and Railway	Net Railway Operating Income 1935	1934	Total Income 1935	1934	Total Deductions 1935	1934	Net Income 1935	1934
Eastern District:								
New England Region	$18,145,939	$16,110,918	$29,109,868	$27,319,472	$32,718,526	$32,989,095	*$3,608,658	*$5,669,623
Great Lakes Region	89,973,052	76,669,374	121,602,415	110,685,965	123,840,228	126,324,107	*2,237,813	*15,638,142
Central Eastern Region	126,982,300	116,901,932	176,814,631	169,606,726	150,677,604	149,722,387	26,137,027	19,884,339
Total, Eastern District	235,101,291	209,682,224	327,526,914	307,612,163	307,236,358	309,035,589	20,290,556	*1,423,426
Southern District:								
Pocahontas Region	74,857,221	66,732,626	79,740,456	72,147,022	18,796,091	19,721,415	60,944,365	52,425,607
Southern Region	[1]49,290,103	54,523,781	[1] 58,425,892	65,595,617	82,949,479	84,824,079	[1*]24,523,587	*19,228,462
Total, Southern District	[1]124,147,324	121,256,407	[1] 138,166,348	137,742,639	101,745,570	104,545,494	[1] 36,420,778	33,197,145
Western District:								
Northwestern Region	50,061,143	41,246,438	67,320,852	61,098,040	101,096,600	100,367,568	*33,775,748	*39,269,528
Central Western Region	69,938,005	71,163,255	[2] 117,661,249	117,685,542	105,734,416	105,883,083	[2]11,926,833	11,802,459
Southwestern Region[3]	20,806,486	22,340,282	24,416,407	26,402,035	59,566,364	60,147,130	*35,149,957	*33,745,095
Total, Western District	140,805,634	134,749,975	[2]209,398,508	205,185,617	266,397,380	266,397,781	[2*]56,998,872	*61,212,164
United States	[1]500,054,249	465,688,606[4]	[2]675,091,770	650,540,419	675,379,308	679,978,864	[1 2*]287,538	[4*]29,438,445
Akron, Canton & Youngstown Ry.‡	383,048	286,761	526,524	437,696	282,501	321,258	244,023	116,438
Atchison, Topeka & Santa Fe Ry.[5]	15,703,352	15,229,319	22,749,966	20,179,851	13,195,651	13,178,537	9,554,315	7,001,314
Atlantic Coast Line System:								
Atlanta & West Point R. R.	*50,433	*153,636	*26,125	*132,177	604	1,371	*26,729	*133,548
Atlanta, Birmingham & Coast R. R.	*96,639	*333,300	*63,780	*299,806	25,257	17,758	*89,037	*317,564
Atlantic Coast Line R. R.	2,578,763	4,289,557	5,023,756	7,076,445	7,553,211	7,571,923	*2,529,455	*495,478
Charleston & Western Carolina Ry.	326,335	381,262	350,655	407,247	302,929	304,509	47,726	102,738
Clinchfield R. R.	2,047,003	2,043,294	2,559,269	2,591,763	2,559,269	2,591,763	.....	.....
Georgia R. R.—Lessee Organization	512,891	578,960	544,881	597,467	697,711	695,028	*152,830	*97,561
Louisville & Nashville R. R.	13,961,959	12,967,297	14,787,082	13,777,330	10,658,139	10,809,945	4,128,943	2,967,385
Nashville, Chattanooga & St. Louis Ry.	523,010	953,544	755,305	1,197,237	1,546,765	1,549,176	*791,460	*351,939
Western Ry. of Alabama	*48,598	*55,650	*7,115	*12,086	70,187	70,528	*77,302	*82,614
Baltimore & Ohio System:								
Alton R. R.	*416,226	221,040	*319,572	305,257	1,822,596	1,949,836	*2,142,168	*1,644,579
Baltimore & Ohio R. R.	24,298,957	23,677,939	31,279,398	30,173,071	34,460,307	33,998,823	*3,180,909	*3,825,752
Staten Island Rapid Transit Ry.	*507,611	*242,795	485,037	489,306	485,037	489,306	.....	.....
Bangor & Aroostook R. R.	1,593,512	1,693,743	1,635,791	1,739,031	762,038	791,637	873,753	947,394
Bessemer & Lake Erie R. R.	2,984,691	1,307,203	3,166,256	1,537,705	1,162,760	1,147,295	2,003,496	390,410
Boston & Maine R. R.	6,617,918	6,893,514	7,770,154	7,923,658	7,563,389	7,630,165	206,765	293,493
Burlington-Rock Island R. R.	*326,628	*283,443	*305,053	*276,000	751,497	751,449	*1,056,550	*1,027,449
Burlington Route:								
Chicago, Burlington & Quincy R. R.	10,228,355	12,650,936	11,309,248	13,905,104	9,466,405	9,450,345	1,842,843	4,454,759
Colorado & Southern Ry.	349,352	144,619	3,366,474	1,428,987	2,152,502	2,283,125	1,213,972	*854,138
Fort Worth & Denver City Ry.	1,180,639	1,239,355	1,268,559	1,362,029	1,306,971	1,415,827	*38,412	*53,798
Cambria & Indiana R. R.	838,052	657,824	859,342	701,146	110,176	117,744	749,166	583,402
Canadian National System:								
Canadian National Lines in New England	*824,179	*789,952	593,213	663,559	562,503	566,679	30,710	96,880
Central Vermont Ry.	319,536	109,574	415,420	140,729	1,205,076	1,208,921	*789,656	*1,068,192
Duluth, Winnipeg & Pacific Ry.	*141,977	*43,050	481,059	830,495	481,142	503,348	*83	327,147
Grand Trunk Western R. R.	2,015,858	392,467	2,686,656	1,230,849	2,978,477	2,870,813	*291,821	*1,639,964
Canadian Pacific System:								
International Ry. Co. of Maine	*179,768	*38,382	146,580	84,343	146,580	146,580	.....	*62,237
Canadian Pacific Lines in Vermont	*488,489	*462,482	264,066	264,066	264,066	264,066	.....	.....
Duluth, South Shore & Atlantic Ry.	369,590	138,595	386,132	123,581	945,953	950,725	*559,821	*827,144
Minneapolis, St. Paul & Sault Ste. Marie Ry.	1,478,904	1,243,926	1,569,662	1,213,457	6,794,009	6,292,000	*5,224,347	*5,078,543
Spokane International Ry.‡	*18,887	*57,253	*13,583	*52,295	274,422	272,855	*288,005	*325,150
Chesapeake & Ohio Ry.	39,937,282	36,997,795	40,949,005	38,051,290	9,909,520	9,988,887	31,039,485	28,062,403
Chicago & Eastern Illinois Ry.‡	622,754	641,697	803,680	789,964	2,273,927	2,284,165	*1,470,247	*1,494,201
Chicago & Illinois Midland Ry.	820,030	804,488	1,097,484	1,049,900	887,877	906,624	209,607	143,276
Chicago & North Western System:								
Chicago & North Western Ry.‡	3,578,484	5,202,104	5,951,939	8,539,846	17,022,287	16,816,040	*11,070,348	*8,276,194
Chicago, St. Paul, Minneapolis & Omaha Ry.	175,578	601,985	246,479	687,178	2,549,187	2,610,388	*2,302,708	*1,923,210
Chicago Great Western R. R.‡	1,307,386	1,200,499	1,432,977	1,350,396	1,951,229	1,962,801	*518,252	*612,405
Chicago, Indianapolis & Louisville Ry.‡	210,703	119,800	231,691	145,478	1,546,156	1,561,792	*1,314,465	*1,416,314
Chicago, Milwaukee, St. Paul & Pacific R. R.‡	4,723,983	6,539,054	6,122,334	7,941,063	24,131,082	24,188,684	*18,008,748	*16,247,621
Columbus & Greenville Ry.	64,944	*3,410	84,642	16,894	21,610	24,266	63,032	*7,372
Delaware & Hudson R. R.	1,361,885	2,118,875	1,550,894	2,307,263	4,325,871	4,908,326	*2,774,977	*2,601,063
Delaware, Lackawanna & Western R. R.	3,587,608	4,504,179	4,736,668	6,024,630	7,668,973	7,997,242	*2,932,305	*1,972,612
Denver & Rio Grande Western R. R.‡	2,417,975	2,311,564	2,719,978	2,796,082	5,988,776	5,771,954	*3,268,798	*2,975,872
Denver & Salt Lake Ry.	1,260,698	913,122	1,327,018	1,012,952	1,237,191	1,000,459	89,827	12,493
Detroit & Mackinac Ry.	63,544	101,920	66,239	107,506	119,399	121,851	*53,160	*14,345
Detroit & Toledo Shore Line R. R.	1,037,662	731,070	1,051,771	746,849	121,106	123,285	930,665	623,564
Detroit, Toledo & Ironton R. R.	3,257,259	1,953,028	3,290,497	1,977,024	789,016	839,235	2,501,481	1,137,789
Duluth, Missabe & Northern Ry.	3,765,586	1,981,648	4,110,499	2,883,707	1,509,592	1,537,255	2,600,907	1,346,452
Elgin, Joliet & Eastern Ry.	2,870,358	661,634	2,946,311	724,031	1,826,831	1,113,090	1,119,480	*389,059
Erie System:								
Erie R. R.[6]	12,960,726	12,699,832	14,713,599	15,073,070	15,565,999	15,674,104	*852,400	*601,034
New Jersey & New York R. R.	*421,856	*436,831	*416,928	*433,151	52,010	52,748	*468,938	*485,899
New York, Susquehanna & Western R. R.	356,977	343,186	420,639	416,079	799,981	801,117	*379 342	*385,038
Florida East Coast Ry.†	222,593	225,476	*137,832	298,392	3,084,927	3,104,983	*3,222,759	*2,806,591
Fort Smith & Western Ry.†	*35,377	*29,464	*34,750	*29,004	293,653	293,446	*328,403	*322,450
Frisco Lines:								
Fort Worth & Rio Grande Ry.	*265,161	*269,224	*257,736	*265,737	113	140	*257,849	*265,877

* Deficit or other reverse items.
† Report of receiver or receivers.
‡ Report of trustee or trustees.
[1] Reduced by $5,277,177 charged to operating expenses in December 1935 by the Illinois Central R. R., and The Yazoo & Mississippi Valley R. R., on account of equipment repairs made in 1934.
[2] Excludes $62,527,087 representing a dividend distribution of securities from the Oregon Short Line Railroad Company to the Union Pacific Railroad Company—an intra-system transaction.
[3] Does not include Gulf, Colorado & Santa Fe and Texas & New Orleans, the income items of which are included in returns made by Atchison, Topeka & Santa Fe and Southern Pacific Transportation System, respectively, in Central Western Region.
[4] This figure differs from the net income shown in Statement No. 33 in the Statistics of Railways for 1934 due principally to the elimination of intra-system dividends. Figures for 1934 and 1935 are comparable in this statement.
[5] Includes Atchison, Topeka & Santa Fe, Gulf, Colorado & Santa Fe, and Panhandle & Santa Fe.
[6] Includes Chicago & Erie R. R. and Erie R. R.

Selected Income Items by Regions and Districts, Class I Steam Railways, Calendar Years 1935 and 1934—Continued

Region and Railway	Net Railway Operating Income 1935	Net Railway Operating Income 1934	Total Income 1935	Total Income 1934	Total Deductions 1935	Total Deductions 1934	Net Income 1935	Net Income 1934
St. Louis-San Francisco Ry.‡	$2,045,513	$2,934,814	$2,622,086	$3,665,046	$13,107,820	$13,249,036	*$10,485,734	*$9,583,990
St. Louis, San Francisco & Texas Ry.	*503,422	*531,632	*492,557	*519,713	136,933	136,867	*629,490	*656,580
Georgia & Florida R. R.†	20,677	*61,604	36,694	*45,787	656,158	630,743	*619,464	*676,530
Great Northern Ry.	23,483,854	14,101,650	27,300,163	18,939,827	20,160,303	20,014,307	7,139,860	*1,074,480
Green Bay & Western R. R.	133,036	21,931	171,654	45,477	15,490	18,210	156,164	27,267
Gulf, Mobile & Northern R. R.	1,100,943	512,547	1,211,959	630,053	807,249	800,793	404,710	*170,740
Illinois Central System:								
Central of Georgia Ry.†	1,039,510	675,683	1,441,364	1,092,220	3,689,562	3,699,562	*2,248,198	*2,607,342
Gulf & Ship Island R. R.	*95,752	*150,098	*75,046	*128,041	85,908	92,489	*160,954	*220,530
Illinois Central R. R.	[7]6,108,950	12,688,092	[7]7,919,900	15,562,163	16,523,662	16,567,771	[7]*8,603,762	*1,005,608
Yazoo & Mississippi Valley R. R.	[8]560,293	734,093	[8]611,927	792,718	1,940,565	2,796,961	[8]*1,328,638	*2,004,243
Illinois Terminal Co.	1,219,921	1,003,617	1,332,750	1,110,788	1,574,048	1,506,695	*241,298	*395,907
Kansas City Southern	1,486,403	1,291,453	1,927,145	1,947,523	2,882,876	2,956,650	*955,731	*1,009,127
Kansas, Oklahoma & Gulf Ry.	551,037	521,824	619,024	592,388	232,117	224,200	386,907	368,188
Lake Superior & Ishpeming R. R.	834,857	270,648	868,661	312,119	362	344	868,299	311,775
Lehigh & Hudson River Ry.	192,796	151,689	224,396	185,278	582	941	223,814	184,337
Lehigh & New England R. R.	822,797	761,746	849,996	789,884	416,287	427,306	433,709	362,578
Lehigh Valley R. R.	4,982,747	5,338,991	6,011,543	6,198,454	7,855,344	8,089,595	*1,843,801	*1,891,141
Louisiana & Arkansas Ry.	1,132,072	1,007,116	1,226,007	1,102,205	797,023	810,403	428,984	291,802
Louisiana, Arkansas & Texas Ry.	44,923	23,878	46,820	25,889	46,153	56,003	667	*30,114
Maine Central R. R.	1,809,732	1,838,069	2,320,562	2,191,357	2,186,021	2,156,106	134,541	35,251
Midland Valley R. R.	421,752	407,353	528,843	512,754	464,369	453,135	64,474	59,619
Minneapolis & St. Louis R. R.†	101,621	40,723	190,148	108,474	3,045,793	3,051,546	*2,855,645	*2,943,072
Mississippi Central R. R.	25,616	*18,437	26,971	*17,044	131,656	124,871	*104,685	*141,915
Missouri & Arkansas Ry.	22,770	63,322	24,507	65,464	74,563	253,218	*50,056	*187,754
Missouri-Kansas-Texas Lines[9]	1,920,843	1,708,707	2,514,319	2,129,916	4,963,397	4,920,522	*2,449,078	*2,790,636
Missouri Pacific System:								
Beaumont, Sour Lake & Western Ry.‡	*33,410	*138,205	*30,432	*136,166	175,126	175,440	*205,558	*311,606
International-Great Northern R. R.‡	529,900	1,370,550	571,468	1,456,382	2,856,594	2,873,750	*2,285,126	*1,417,368
Missouri-Illinois R. R.‡	51,122	59,775	53,597	65,486	138,855	136,967	*85,258	*71,481
Missouri Pacific R. R.‡	5,230,583	6,118,046	6,056,457	7,134,608	21,298,153	21,336,426	*15,241,696	*14,201,818
New Orleans, Texas & Mexico Ry.‡	443,568	523,390	518,090	595,854	2,665,482	2,668,057	*2,147,392	*2,072,203
St. Louis, Brownsville & Mexico Ry.‡	428,509	713,990	476,726	762,989	837,589	850,552	*360,863	*87,563
San Antonio, Uvalde & Gulf R. R.‡	*319,135	34,040	*311,040	39,000	220,679	221,082	*531,719	*182,082
Texas & Pacific Ry.	5,052,104	4,732,752	5,528,461	5,242,535	4,146,183	4,210,591	1,382,278	1,031,944
Monongahela Ry.	1,114,371	1,081,739	1,128,328	1,094,356	728,640	845,958	399,688	248,398
Montour R. R.	844,898	774,331	898,418	847,922	86,959	88,792	811,459	759,130
Nevada Northern Ry.	87,607	36,401	103,768	62,051	665	617	103,103	61,434
New Haven System:								
New York, New Haven & Hartford R. R.‡	8,179,548	5,617,020	14,725,626	12,948,441	18,286,095	18,480,555	*3,560,469	*5,532,114
New York, Ontario & Western Ry.	1,360,560	1,252,077	1,600,072	1,496,541	1,596,486	1,574,961	3,586	*78,420
New York Central Lines:								
New York Central R. R.	36,748,524	29,160,928	60,003,318	53,217,582	59,888,272	60,899,917	115,046	*7,682,335
Pittsburgh & Lake Erie R. R.	3,762,399	3,304,833	4,168,839	3,997,270	923,466	1,076,108	3,245,373	2,921,162
New York, Chicago & St. Louis R. R.	6,759,546	5,509,427	8,650,491	7,588,976	7,534,562	7,530,342	1,115,929	58,634
New York Connecting R. R.	1,256,610	1,263,624	1,301,844	1,316,741	1,323,164	1,321,737	*21,320	*4,996
Norfolk & Western Ry.	27,303,818	22,518,286	29,988,981	25,625,357	4,442,531	5,160,864	25,546,450	20,464,493
Norfolk Southern R. R.†	325,428	489,653	480,991	655,479	902,801	991,414	*421,810	*335,935
Northern Pacific Ry.	7,726,341	7,915,209	14,959,644	15,452,756	14,527,863	14,553,349	431,781	899,407
Oklahoma City-Ada-Atoka Ry.	60,979	*10,377	65,167	*7,212	2,863	81,438	62,304	*88,650
Pennsylvania System:								
Long Island R. R.	540,687	2,522,160	914,713	3,027,379	2,322,554	2,548,689	*1,407,841	478,690
Pennsylvania R. R.	70,394,641	64,135,287	106,808,064	104,149,178	82,958,266	82,515,214	23,849,798	21,633,964
Pennsylvania-Reading Seashore Lines	*1,697,564	*1,817,395	*1,527,125	*1,566,535	1,095,920	1,195,767	*2,623,045	*2,762,302
Pere Marquette Ry.	4,828,197	2,618,368	5,194,916	3,038,858	3,561,618	3,650,985	1,633,298	*612,127
Pittsburg & Shawmut R. R.†	39,039	94,516	70,622	130,193	122,260	123,011	*51,638	7,182
Pittsburgh & West Virginia Ry.	1,033,185	835,969	1,045,195	850,859	949,699	943,130	95,496	*92,271
Pittsburg, Shawmut & Northern R. R.	*12,920	*57,694	*4,328	*42,263	127,866	128,108	*132,193	*170,371
Reading System:								
Central R. R. of New Jersey	2,192,693	3,060,753	3,232,680	4,089,577	5,579,418	5,634,647	*2,346,738	*1,536,070
Reading Co.	12,562,360	12,856,973	15,102,486	15,217,276	9,388,313	9,535,222	5,714,173	5,682,054
Richmond, Fredericksburg & Potomac R. R.	375,857	443,987	570,839	655,390	326,033	331,119	244,806	324,271
Rock Island System:								
Chicago, Rock Island & Gulf Ry.‡	84,360	*48,845	219,498	56,806	1,431,062	1,424,510	*1,211,564	*1,367,704
Chicago, Rock Island & Pacific Ry.‡	*1,023,558	1,727,645	*372,182	2,382,518	14,651,389	14,326,215	*15,023,571	*11,943,697
Rutland R. R.	*138,481	*13,810	*63,388	47,547	419,594	422,649	*482,982	*375,102
Seaboard Air Line Ry.†	1,501,943	1,631,913	1,825,706	2,023,132	9,435,071	10,052,685	*7,609,365	*8,029,557
Southern System:								
Alabama Great Southern R. R.	429,547	661,908	801,282	1,039,560	497,846	491,865	303,436	547,695
Cincinnati, New Orleans & Texas Pacific Ry.	3,583,309	3,257,307	3,706,016	3,384,902	1,729,394	1,751,623	1,976,622	1,633,279
Georgia Southern & Florida Ry.	104,514	115,244	113,037	121,828	316,353	322,550	*203,316	*200,722
Mobile & Ohio R. R.†	72,131	*30,048	137,608	28,071	1,721,375	1,732,292	*1,583,767	*1,704,221
New Orleans & Northeastern R. R.	194,512	81,609	221,693	109,586	400,167	397,293	*178,474	*287,707
Northern Alabama Ry.	20,979	41,761	21,286	42,479	109,436	109,452	*88,150	*66,973
Southern Ry.	14,290,530	12,665,357	15,655,538	14,441,048	17,178,731	17,214,184	*1,523,193	*2,773,136
Southern Pacific System:								
Northwestern Pacific R. R.	*36,714	*8,010	*11,880	23,382	1,463,120	1,463,506	*1,475,000	*1,440,124
St. Louis Southwestern Lines[10]	2,644,318	1,958,645	2,722,914	2,045,582	3,178,109	3,191,019	*455,195	*1,145,437
San Diego & Arizona Eastern Ry.	*138,102	*74,229	*94,518	*35,620	59,582	61,173	*154,100	*96,793
Southern Pacific Transportation System[11]	20,319,880	17,003,658	34,500,869	33,233,919	32,154,279	32,825,694	2,346,590	408,225
Spokane, Portland & Seattle Ry.	1,739,173	1,540,713	2,245,553	1,684,052	3,733,732	3,669,299	*1,488,179	*1,985,247
Tennessee Central Ry.	410,331	335,407	418,228	344,544	302,936	306,281	115,292	38,263
Texas Mexican Ry.	184,950	144,796	197,335	155,728	180,122	181,583	17,213	*25,855
Toledo, Peoria & Western R. R.	212,988	159,765	230,869	175,328	89,349	74,881	141,520	100,447
Union Pacific System:								
Los Angeles & Salt Lake R. R.	2,817,473	3,061,840	2,955,794	3,146,517	2,668,959	2,678,467	286,835	468,050
Oregon Short Line R. R.	4,272,715	3,248,961	5,884,133	4,883,366	3,669,406	3,566,916	2,214,727	1,316,450
Oregon-Washington R. R. & Navigation Co.	803,614	548,056	1,297,531	1,037,907	3,954,154	3,926,417	*2,656,623	*2,888,510
St. Joseph & Grand Island Ry.	680,767	528,350	775,642	622,049	179,167	169,415	596,475	452,634
Union Pacific R. R.	10,721,266	11,585,526	[12]29,015,626	30,118,258	16,354,565	10,366,899	[12]18,661,061	19,751,359
Utah Ry.	198,865	*35,184	207,929	*22,396	226,026	226,138	*18,097	*248,534
Virginian Ry.	7,240,264	6,772,558	8,231,631	7,814,985	4,118,007	4,240,545	4,113,624	3,574,440
Wabash System:								
Ann Arbor R. R.†	482,558	374,659	496,571	393,309	442,569	445,597	54,002	*52,288
Wabash Ry.†	5,213,899	4,355,273	5,595,158	4,724,505	7,863,626	7,832,126	*2,268,468	*3,107,621
Western Maryland Ry.	4,107,677	4,106,178	4,252,172	4,275,956	3,249,515	3,280,701	1,002,657	995,255
Western Pacific R. R.‡	1,016,313	1,267,422	1,824,030	2,049,102	3,616,755	3,648,569	*1,792,725	*1,599,467
Wheeling & Lake Erie Ry.	2,670,574	1,764,829	2,818,416	1,904,446	656,303	706,897	2,162,113	1,197,549
Wichita Falls & Southern R. R.	89,395	47,951	202,606	162,004	254,950	252,093	*52,344	*90,089

* Deficit or other reverse items.
† Report of receiver or receivers.
‡ Report of trustee or trustees.
[7] Reduced by $4,821,354 charged to operating expenses in December 1935 on account of equipment repairs made in 1934.
[8] Reduced by $455,823 charged to operating expenses in December 1935 on account of equipment repairs made in 1934.
[9] Includes Missouri-Kansas-Texas R. R. and Missouri-Kansas-Texas R. R. of Texas.
[10] Includes St. Louis Southwestern Ry. and St. Louis Southwestern Ry. of Texas.
[11] Includes Southern Pacific Company and Texas & New Orleans R. R. The figures shown exclude offsetting debits and credits for rent for leased roads, bond interest, and dividends, between companies included. Also excludes dividends received from separately operated solely controlled companies during period January 1 to December 31, 1935, $1,437,193.75 and January 1 to December 31, 1934 $3,622,600.00.
[12] Excludes $62,527,087 representing a dividend distribution of securities from the Oregon Short Line Railroad Company to the Union Pacific Railroad Company—an intra-system transaction.

R. H. Ford
President

A. R. Wilson
President-Elect

E. H. Fritch
Secretary

A.R.E.A. Holds Enthusiastic Convention

Confidence in the future of the association is keynote of three-day meeting at Chicago

WITH an optimism born of an upward trend of railway earnings and an outlook for a material expansion of its field of usefulness to the railways, the American Railway Engineering Association carried out the three-day program of its thirty-seventh annual convention with greater enthusiasm than has been evidenced at any of its meetings since the advent of the depression. As for a number of years in the past, the sessions were held in the Grand ballroom of the Palmer House, Chicago, commencing on Tuesday morning and closing on Thursday afternoon.

The future of the association, with particular reference to the part that it is to have in broadened programs for research, was depicted by Robert H. Ford, assistant chief engineer, Chicago, Rock Island & Pacific, in his address as president of the association on Tuesday morning. In this he made a particular point of the fact that the association has already carried on extensive research work from which the railways have derived marked economic advantages.

With a program embracing the presentation of reports by 30 standing and special committees, the presiding officer was confronted with an exceedingly tight schedule, but by the exercise of discrimination attention was focused on the major features of the vast amount of material offered by the committees for the purpose of eliciting the fullest possible discussion of the selected subject matter. According to the report of E. H. Fritch, secretary, the receipts during the past year exceeded the expenditures by $3,690.27, and the membership on March 1, 1936, totaled 1,936, an increase of 30 during the year. Activity of the membership is indicated by the participation of 913 members in the work of the committees. The registration totaled 662 members and 248 guests, a total of 910, as compared with a registration of 619 members and 288 guests, a total of 907, last year. This attendance was larger than that in any recent year.

No evening sessions were held and in lieu of a banquet, which was abandoned several years ago, the association presented a luncheon on Wednesday, at which Ralph Budd, president of the Chicago, Burlington & Quincy, spoke to more than 700 members and guests on New Opportunities for the Railways. In this address, which was broadcast by the National Broadcasting Company, Mr. Budd emphasized the opportunities confronting engineering and maintenance of way officers in adopting the most efficient materials, devices and methods while taking up the large accumulation of deferred maintenance that now exists. Mr. Budd laid special emphasis on the importance of research, stating that today's conditions present "a real opportunity for joint effort and a challenge to the ability of the railways to co-ordinate in the interest of the whole industry." "The motif of this decade is speed," he said, "and our work must be keyed to a new tempo." Mr. Budd's address will be published in the *Railway Age* of next week.

New Officers

At the concluding session on Thursday afternoon the following officers were declared elected and installed: President, A. R. Wilson, engineer bridges and buildings, Penna., Philadelphia, Pa.; second vice-president, F. E. Morrow, chief engineer, C. & W. I.-Belt Ry., Chicago; secretary, E. H. Fritch (re-elected); treasurer, A. F. Blaess, chief engineer, I. C., Chicago (re-elected). Directors: H. R. Clarke, engineer maintenance of way, C. B. & Q., Chicago; F. L. C. Bond, general superintendent, Central region, C. N. R., Montreal; W. M. Post, assistant chief signal engineer, Penna., Philadelphia, Pa. In addition, J. C. Irwin, valuation engineer,

B. & A., Boston, Mass., was advanced automatically to first vice-president.

President Ford's Address

Many important contributions to the science of railway engineering have been made through the association during the year. Perhaps the most important is the specifications for the design of steel railway bridges and concrete railway structures, which were published by the association under the auspices of the Association of American Railroads. These specifications, consisting of 260 pages, were prepared to meet the increasing need for a standardized work on bridge design and construction. It has been most favorably received by public authority and the engineering profession generally.

The revision of the Manual has been actively continued during the year, and the newly revised edition will be published as soon as possible after the annual meeting. The new edition, which will represent 37 years of intelligent work and the sustained efforts of thousands of earnest engineers, will contain approximately 1,850 pages. It is not difficult to predict that the Manual, when completed and published, will take front rank among standard engineering encyclopedia.

Association's Work Has Broad Scope

The association, through its members, has made many outstanding contributions to engineering research and literature. A particularly fine example of research work of great value to the railroads and to the public generally, is the contribution of J. B. Hunley, engineer of bridges and structures of the Cleveland, Cincinnati, Chicago & St. Louis, the results of which were published by the association in Bulletin No. 380, dated October, 1935.

Approximately 13 per cent of the roadway investment of the railroads is in bridges. In designing bridges, an amount of metal must be added to take up the shock which results from moving trains. This is known as impact. Originally, the allowance for impact was based upon arbitrary determinations, but by the application of more scientific methods it has become increasingly evident that large savings are possible both by reducing and reapportioning the amount of metal which, under present practices, is being put into bridges. This is equally true as regards extending the service life of existing bridges.

The railways expend approximately $23,000,000 annually on bridges. Of this amount, approximately $11,000,000 is for new structures and $12,000,000 for the replacement of light bridges. The Committee on Iron and Steel Structures estimates that, based upon data and results already obtained, a saving of about $2,000,000 annually could be made if it had at its command the necessary scientific data on the true effect of impact on railway bridges. Study is now being made in this regard, which the committee estimates will require about three years to complete.

Valuable Work on Rail and Water Service

The Committee on Rail is engaged on some of the most important problems of research thus far undertaken by the association. Some especially interesting and valuable research work of high character has been done in connection with the troublesome and complicated problem of transverse fissures. This has been carried out largely by the Committee on Rail, working jointly with the rail manufacturers' technical committees and the engineering experiment station of the University of Illinois, the latter being in charge of Research Professor H. F. Moore. The cost of this investigation to date has been approximately $200,000, contributed equally by the users and manufacturers.

For years very little has been actually known of the action and resulting strengths developed in the various parts of the railway subgrade and track structure under passing train loads at high, moderate and low speeds. It has been known, however, that in combination, these little understood forces exert a powerful effect on railway maintenance and renewal costs and, doubtless, influence safety of operation as well. The final identification of these forces may ultimately result in revolutionary changes in the track structure, which will render it capable of sustaining moving train loads at greatly increased speeds. In any event, it is apparent that the results of this increased knowledge will greatly increase the ability of railway engineers to design and construct a better and more economically maintained track structure. The work in this regard is being conducted under a nationally known scientist, Dr. A. N. Talbot, professor emeritus of the University of Illinois and a former director of this association.

The railroads use more water for boiler purposes that any other major industry. Because of the conditions under which locomotives must operate, boiler water conditioning is of the greatest importance to efficient and economical railway operation. All natural waters carry impurities. The effects of these impurities are pitting, corrosion, scale formation, embrittlement or cracking of steel, and the foaming and priming of boilers. In addition to the normal savings being made currently by the treatment of locomotive boiler waters, the Committee on Water Service reports that annual savings of not less than $12,000,000 can be made by further improved methods for the conditioning of water to make it suitable for boiler purposes. Indeed some authorities have placed this saving as high as $40,000,000 annually.

Full Freedom of Initiative and Expression

For nearly 40 years the American Railway Engineering Association has engaged in vast research undertakings in the field of railway transportation, largely through the agency of volunteer committees that have worked for the pure joy of accomplishment rather than for personal aggrandizement. Throughout these years, the work of the association has been so organized and conducted as always to remain free from the dominance and control of any individual or interest. Consistently, it has clung to the belief stated so well nearly 20 years ago by former president Charles A. Morse, that the most valuable results can be secured by an association composed of individual members who are free to give expression to their beliefs. As he pointed out at that time, the engineering mind must be free in its research work and, therefore, must be adaptable to changing conditions.

The engineer is primarily concerned with the assembly of facts necessary for the solution of definite problems to be analyzed and thereafter interpreted in the light of scientific truth. This is the principle upon which the work of this association is based. But the fact that the work is conducted through the agency of committees is confusing at times to uninformed persons, who apparently assume that the deliberations of engineering committees are comparable with the work of the usual run of popular committee organizations. This is erroneous. There is no comparison either in the character of purpose or methods of work.

The committee work of this association embraces two fields of usefulness, each of which presents opportunities for education and the dissemination of knowledge among its members. The first field deals with the immediate needs of current operating experience, whereby mechanisms and practices within the industry may become increasingly adaptable or efficient, to the end that railway service may, in turn, become increasingly cheaper and better. The second field is concerned with the application of new or possibly not heretofore applied discoveries in the field of fundamental science, a knowledge of which is inspired by the necessity of producing something that will effect more or less revolutionary changes in existing properties.

Conditions largely beyond the control of the railway industry have demanded that it be concerned chiefly with the solution of problems arising out of immediate necessities, largely to the exclusion of exploratory work of the type conducted by other major industries for developments that definitely transcend current needs. Our committees do not have at their command the vast financial resources or the great laboratories manned with highly trained technical personnel and directed by outstanding scientists, but, what may perhaps be of greater significance, they do have available the splendid laboratories and trained personnel of our great universities and the unexcelled opportunities for closer and reciprocal relationships which this affords. It would appear that the ultimate interest of transportation lies not in a further duplication of laboratories or of skilled, scientific personnel in separately functioning research departments, but rather with these great training schools of youth, with their splendid equipment and personnel.

Much Still to be Done

The needs of the present differ widely from those of the past. Owing to the enormous programs of expansion that have been

carried out in recent years, the transportation facilities now available greatly exceed the public needs of the present and the immediate future. This points at once to the necessity of focusing the attention of our engineers for some years to come largely in the direction of the perfection and harmonization of existing agencies, to the end that they will better meet the current operating requirements, rather than on new and extensive projects for increasing traffic capacity. But this does not imply any lessening of the need for research. There is indeed an urgent call for engineering investigations, conducted possibly along a broader scope than heretofore and unfettered by prejudices or preconceived conclusions, that will be fruitful of basic truths concerning the many perplexing difficulties that beset the railways in these trying times.

The transportation industry is not greatly in need of new captains and generals, as some would have you believe, but, on the other hand, there is always a definite need for material from which the captains and generals of the future can be developed. The rail industry must in the future draw heavily upon qualified young men, trained largely in our technical schools and colleges, if its mechanism is to reach the objective of better and cheaper transportation, coupled with increasing efficiency.

Report of Committee on Roadway

Geo. S. Fanning, Chairman *

In a report covering all five of its assignments, the committee presented revisions of the present specifications in the Manual for corrugated metal culvert pipe and formation of the roadway, and recommended the deletion of considerable other material. In addition, it presented a complete outline of its work.

Service Life of Culverts—Continuing its compilation of data on the service life of various types of culverts, including corrugated metal, concrete pipe, vitrified clay, cast iron pipe, concrete and masonry, the committee made report on 10,663 culvert installations in the United States and Canada. After discussing its method of determining the expected life of each installation and pertinent facts with regard to each type of culvert construction, the committee offered the following conclusions as information:

From the information received and computed, the following average service life may be expected of existing culverts of the various materials:

(1) Corrugated metal pipe..... 33 years
(2) Concrete pipe ..... 67 years
(3) Vitrified clay ..... 70 years
(4) Cast iron pipe..... 81 years
(5) Concrete culverts ..... 92 years
(6) Stone masonry .....151 years

These figures are the average expected life of the particular groups of culverts inspected and are based on the method of rating adopted by the committee. In all probability, some of the culverts of each group (1) were not designed for the loading they are now called on to carry; (2) were not of the type best suited to the particular location; (3) were not built to present-day standards of workmanship and material; and (4) did not have incorporated in them the features which experience has shown to be desirable in connection with each type of installation.

In view of the foregoing, the committee is of the opinion that new culverts of proper design and material, installed with care, and with consideration given to such auxiliaries as wing walls and aprons where necessary, will have a service life greater than that shown.

Supplementing its written report, the committee presented in tabular form a summary statement of the service records, ratings and expected life of all of the culverts included in its considerations.

Considerable discussion centered around the table giving the average service life that may be expected from different types of culverts. B. R. Leffler (N. Y. C.) questioned the basis upon which the figures given were arrived at, and saw the possibility of wide error in the estimated average life of the first three types of culvert pipe listed. He objected particularly to the committee's offering the service life data as conclusions, which, he said, might put the association on record to its embarrassment at some future date.

C. W. Baldridge (A. T. & S. F.), supported by W. J. Burton (M. P.), called attention to the fact that the committee's calculations do not take into consideration the service life record of various types of culverts which have already failed and have been removed from service. In this he saw marked weakness in the committee's conclusions. G. S. Fanning (Erie), chairman, together with A. E. Botts (C. & O.), subcommittee chairman, explained the method used by the committee in collecting its data, pointing out that the service life figures presented are intended to be considered as relative rather than absolute, as regards each particular type of construction.

E. F. Wendt (consulting engineer) explained briefly the practice of the Bell Telephone Company in arriving at the expected life of various service units and cautioned against what he termed "intelligent guess," rather than basing results upon scientific determinations. F. L. Nicholson (Nor. So.) questioned the service life figures, particularly as regards corrugated metal pipe, on the ground that the deterioration of culverts accelerates with their age, a factor apparently overlooked by the committee. Following further explanation of the purpose of the report by Mr. Botts, in which he urged the acceptance of the material as a guide in the selection of various types of culverts, a motion by Mr. Loeffler that the report be referred back to the committee was lost.

Specifications for Cast Iron Culvert Pipe—During the year the committee gave consideration to the reasons why the A. R. E. A. specifications for cast iron culvert pipe are not more widely used, and, in this connection, inquired into the comparative shell thickness, weight and cost of cast iron culvert pipe under A. R. E. A., American Water Works Association and A. S. T. M. specifications. After tabulating the figures, the committee pointed out that pipe made to A. S. T. M. specifications of a grade equal to or heavier than that of A. R. E. A. specifications is uniformly much lower in cost, except for the 12-in. size, where the heaviest A. S. T. M. grade is 0.04 in. (10 per cent) less in thickness and 23.4 per cent less in cost.

In view of this situation unfavorable to A. R. E. A. specification pipe, the committee recommended that A. R. E. A. specifications (Bulletin 327, pages 6 and 7) be withdrawn from the Manual, and that A. S. T. M. tentative specification A 142-34T be used pending further consideration,

C. W. Baldridge (A. T. & S. F.) objected to removing the specifications from the Manual until the association was ready to accept as recommended practice the A. S. T. M. tentative specifications, but the recommendation of the committee was adopted.

Specifications for Corrugated Metal Pipe—Last year, as the result of a questionnaire, the committee found that a great majority of the railways were not adhering to the association's specifications for corrugated metal culvert pipe. In view of this situation, the committee during the year made an analysis of the reasons for this lack of adherence and then completely revised the existing specifications in accordance with what now appears to be best practice. The revised specifications were submitted as the committee's report, with the recommendation that they be adopted to replace the present specifications appearing in Supplemental Bulletin 327, pages 3 to 6, inclusive.

Certain members of the association were confused by the fact that the committee was recommending the replacing of specifications which, concurrently, were being advocated for general use by the railways by the Committee on Standardization. Following explanation by the committee chairman and E. M. Hastings (R. F. & P.), chairman of the Committee on Standardization, to the effect that the recommendations of the Committee on Standardization will be revised each year to take into account current changes in approved practices adapted by the association, the new specifications prepared by the committee were accepted for publication in the Manual.

Physical Property of Earth Materials—After defining the scope of the study on this subject to include principally the physical properties of unconsolidated earth materials, commonly called soil, that overlie bed rock in greatly varying depth, class, strata and moisture content, the committee pointed out the importance of proper soil selection and treatment to the economical maintenance of good track and to stable foundations for heavy structures. In this regard, it said as follows: The proper selection or treatment of roadbed soils based on knowledge of

* Chief Engineer, Erie.

their physical properties has a major influence on the economical maintenance of track and the operation of trains. Improvement of the quality or condition of the subgrade to support adequately the static load of the track and the heavy live loads and impact of rolling equipment will prevent excessive maintenance expense or, if maintenance be deferred, more rapid deterioration of the track which would adversely affect riding qualities, train schedules and the condition of equipment.

The foundations of heavy structures are subject to inevitable settlement. Utilization of data on the physical properties of bearing soils will permit the economical design of structures that will settle uniformly and within allowable limits, or otherwise maintain stability.

The main body of the report consists of a discussion of soil genesis, the physical properties of soils and the classification of soils. The material in the report with regard to soil genesis consists of extracts taken from the monograph on "Landslides, Subsidences and Rock-Falls," by Dr. George E. Ladd, consulting engineer-geologist, U. S. Bureau of Public Roads, and a member of the committee, published in Bulletin 377, July, 1935.

The report was accepted as information.

Formation of Roadway—Finding that the association's specifications for the formation of roadway, adopted more than 30 years ago, were not being used extensively by the railways, except possibly as a guide, the committee revised these specifications during the year and submitted new specifications for approval and publication in the Manual, replacing the earlier specifications.

The new specifications were adopted.

Roadway Drainage—The committee stated that further study of roadway drainage during the year did not disclose any improvements in practice which justify additions to or changes in recommended practice adopted by the association during the last five years. As information, however, the committee called attention to the rather unusual practice adopted by one road in draining water pockets in fills, in which a caterpillar dragline, operated on the ties, excavated the side of the fill perpendicularly from the ends of the ties, down to the bottom of the water pockets. The material removed was cast far out on the right-of-way, and the excavation was backfilled with coarse material delivered in air dump cars. It was said that the operations have proved highly successful. The committee also commented briefly upon the experience of the same road in correcting a slide by the tunneling method, and upon several other methods of subdrainage.

Tunnels—During the year the committee reviewed all reports which have been submitted to the association which contain any information directly or indirectly with regard to tunnels. It also made a careful search for all articles on railway tunnel construction, ventilation and maintenance, published during the last 25 years. Approximately 160 such articles were found and reviewed. In carrying out its work, the committee reported that it is collaborating with the committees on Economics of Railway Location, Masonry, Signals and Interlocking and Electricity, and also with the Special Committee on Clearances.

Dealing only with tunnel construction in its present report, the committee reviewed briefly the methods of construction and timbering employed in putting through the Connaught, Moffat and Cascade tunnels in the United States and Canada, and the Tanna tunnel in Japan. It called attention to the fact that modern practice does not in general follow the method outlined in the Manual, but stated that since a wide variation in methods of construction is necessary to meet varying conditions, arising even in a single tunnel, it does not appear feasible to recommend any particular practice. In view of this, the committee recommended withdrawal from the Manual of all of the material on tunnel construction, on pages 42 to 44 inclusive. It also recommended a change in the statement with regard to the interior dimensions of tunnels appearing in Bulletin 378, Supplement to the Manual.

Supplementing its report, the committee presented a bibliography of the more important articles on tunnels which have been published during the last 25 years, and also a list of the articles in the association's publications on the same subject, from January, 1916, to August, 1935.

Both recommendations were adopted.

Natural Waterways—The committee devoted its attention largely to the preparation of an outline of its work, and to reviewing the material in the Manual which comes within its field. As a result of its efforts in this latter regard, it recommended deletion from the Manual, as unnecessary, the definitions of "Flood Damage" and "Washout," page 23, and of "Channel" and "Waterway," page 25. It reported that it had been asked by the Special Committee on Manual to recommend removal from the Manual of the figure on page 39, under the subject of waterways, but preferred to give this matter further consideration before making a decision.

Both recommendations were adopted.

Signs—An inquiry sent to 50 railways by the committee disclosed that none of these roads was following in every respect the recommended designs for signs appearing in the Manual. Ten roads had adopted only one A. R. E. A. design, while 28 roads were following none of the association designs. In view of this situation, the committee recommended that all of the material in the Manual with regard to signs, pages 77 to 88, inclusive, be deleted and that the subject be continued for further study.

The recommendation was adopted.

Outline of Work—Through the aid of its different subcommittees, the committee presented a carefully prepared detailed outline of all of the subjects under its jurisdiction.

Other Subjects—In addition to the subjects reported upon as indicated above, the committee gave consideration to two other subjects—roadway protection and fences—but made no report on them.

Uniform General Contract Forms

F. L. Nicholson, Chairman*

After reviewing the various forms which have been adopted by the association, the committee recommended a number of changes, largely in the nature of editing with the view to greater uniformity, simplification and convenience in use. It also presented two new forms for consideration.

Revision of the Manual—Revisions in various adopted forms were recommended to secure simplification of titles; greater uniformity of wording in the opening paragraph of each form in describing the parties to the agreement; greater uniformity in the contract forms where two railways are parties to the agreement; substitution of a uniform arbitration paragraph for the diverse wording of eight existing paragraphs; and the substitution of a uniform executory paragraph in existing forms. The forms affected in one way or another by the recommendations of the committee include the following:

Form of construction contract; agreement for interlocking plant; agreement for crossing of railways at grade; form of lease for industrial site; agreement for industry track; agreement for trackage rights; license for wires, pipes, conduits, drains and other structures on railway property; agreement for placing snow or sand fences off the railway company's property; agreement for joint use of passenger station facilities; agreement for joint use of freight terminal facilities; license for private road crossing; agreement for purchase of electrical energy for other than traction purposes; agreement for purchase of electrical energy for traction and other purposes; agreement for joint use of poles on railway lands; agreement for furnishing water from railway water systems to employees and others; agreement for purchase of water; agreement for the organization and operation of a joint passenger terminal project; agreement for the use of railway property by high pressure pipe lines carrying inflammable oils and gas; and agreement for wire line crossings.

Finding the subheads at the beginning of paragraphs in many of the existing forms to be of great convenience to users, the committee stated its intention of supplying subheads to ten existing forms that are without such heads at the present time, both for the convenience of the user and to make for greater uniformity in style.

The recommendations of the committee were adopted. The committee also recommended the elimination of the "and/or" expression from all Association forms and contracts, which recommendation was approved.

Form of Agreement for Store-Door Delivery—As the result of intensive study of store-door delivery practices and existing forms of agreements in force, and also collaboration with a subcommittee of the Western General Managers' Association that

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is studying this subject, the committee prepared and submitted a tentative form of agreement, embodying all of the terms which, in its judgment, are essential to such an agreement. The various terms or subjects covered in the form are: Contractor's equipment, delivery of freight, freight in contractor's possession, protection of freight, collection of freight charges, bills of lading and delivery orders, inspection of accounts, permits and licenses, compliance with laws, forms of payment of freight charges, charges to other carriers, damage and injury liability for freight, defense of lawsuits, affiliation with another carrier, payment to contractor, employees of contractor, insurance, adjustment claims, refunds, contractor not given exclusive rights, written notices, waiver, assignment of contract, approval by public authorities, and cancellation.

Form of Agreement for Cab Stand Privileges—Without comment the committee presented as information a tentative form of agreement covering cab stand privileges. This form, relatively short in length, embodies best practice as determined from study of the many existing forms in use, and, at the same time, is in line with the general recommendations of the committee for bringing about greater uniformity among the various forms of agreement adopted by the association.

Other Subjects—The committee gave consideration to the development of a form of agreement with public authorities for highway grade crossing elimination or separation, and recommended that this subject be continued.

Report of Committee on Rail

Earl Stimson, Chairman *

The committee presented detailed reports on five of its nine regular assignments, recommended numerous revisions in material appearing in the Manual, and, in addition, outside of its regular assignments, developed and submitted for adoption, plans for head-contact type joint bars for 90-lb. RA-A and for 100-lb. RE rail.

Revision of the Manual—In a thorough review of the Manual and its supplements, the committee found considerable material which it felt could be improved in wording, simplified or made more definite in meaning. Accordingly, it recommended numerous revisions and deletions, and, in several instances, major substitutions. Some of the more important changes recommended dealt with the specifications for rail; rail inspection; rail record forms; specifications for open-hearth steel girder rails of plain, grooved and guard types; girder rail sections; and tables of bolt dimensions. In addition, the committee recommended the revision and rearrangement of all of its definitions in the Manual, and presented a new form of report of rail failures in main track, to be substituted for Form 402-A in the Manual. It also offered for adoption and substitution in the Manual for existing specifications, new specifications for heat-treated carbon steel and alloy steel track bolts; new specifications for high carbon steel joint bars; and new specifications for quenched carbon steel joint bars. All of these revisions, deletions and substitutions were adopted.

Design of Joint Bars—A questionnaire sent out by the committee developed that there is in service, and, in all probability, will continue to be purchased, a large mileage of 90-lb. RA-A and 100-lb. RE rail. In view of this fact and its feeling that present available joint bars for these sections of rail are not as satisfactory as they might be, the committee developed new joint bar designs for both rail sections. These new designs, which were submitted as Exhibits A and B in the report, were recommended for adoption and inclusion in the Manual.

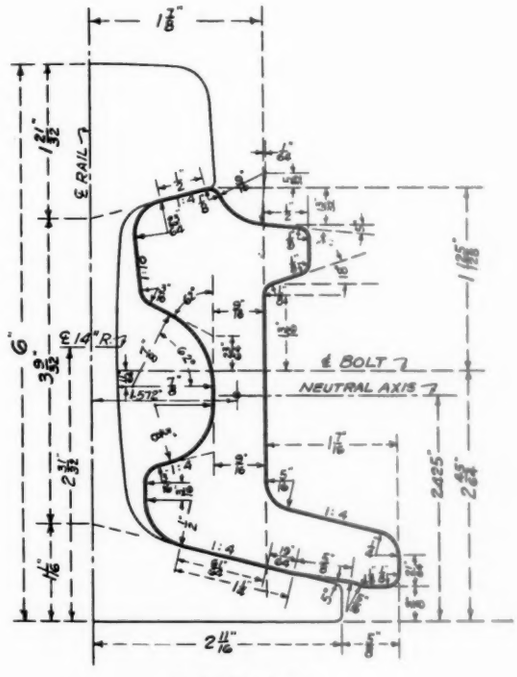
Both designs were adopted, with the single change, suggested by the committee in presenting the report, that the drawings be changed to show the joint bolt nuts beveled on only one side.

Rail Mill Practice and Manufacture—In a brief report, which the committee stated would be amplified on the floor of the convention, the committee announced that upon the completion on December 31, 1935, of the five-year contract between the University of Illinois, the Rail Manufacturer's Technical Committee and the Association of American Railroads for a joint investigation to determine the cause of and remedy for transverse fissures, it had been agreed to extend the investigation for another year. For information concerning the investigation, the committee made reference to the progress report of H. F. Moore, research professor of engineering materials, University of Illinois, who is in charge of the investigation, which report was published in the *Railway Age* for August 31, 1935.

Following the presentation of this report, Professor H. F. Moore supplemented that part of the report dealing with rail mill practice and manufacture, and discussed the latest developments in the rail investigation. Mr. Moore, who is in charge of the investigation, indicated that much of the most recent work has had to do with the cause, development and prevention of shatter cracks in rails, it having been determined by earlier work that such cracks are, in all probability, an important factor in the development of transverse fissures.

He first told of tests for shatter cracks in rails given various thermal treatments during cooling, and said that these tests had indicated unmistakably that proper thermal treatment of rails has a marked effect in preventing this class of rail defect. Not only that, but he pointed out that thus far it has been impossible in the laboratory to develop transverse fissures in thermal treated rail, indicating the value of this treatment in preventing the development of this type of failure.

Discussing the various types of tests being employed to detect shatter cracks in rails, Mr. Moore described and illustrated the bending test which is now being used in conjunction with etching tests, which, he said, while not 100 per cent perfect, has given much better results in detecting shatter cracks than either the single or repeated drop tests.



SECTION

Joint Bar for 100-Lb. RE Rail Recommended for Adoption

On the behavior of rails in service, he discussed the latest field tests conducted to determine the magnitude of wheel loads under various actual service conditions, and then referred to certain studies on impact which are being carried out, which show promise of valuable results.

In conclusion, he held forth no immediate complete solution of the problem of shatter cracks and transverse fissures in rails, in spite of refinements in rail manufacture, and said that the minimizing of transverse fissures in track demanded the closest co-operation between maintenance of way and motive power men.

Rail Failure Statistics for 1934—The report on this subject, as in the past, contained data presented by W. C. Barnes, engineer of tests for the committee, with respect to rail failures. The statistics presented, which were as of December 31, 1934, were compiled, as formerly, in accordance with the standard method of basing the failure rate on mile-years of service in track. Statistics on the 1929 rollings of all mills show that for the five-year period 1930-1934 there was an average of 121.2

* Chief Engineer Maintenance, Baltimore & Ohio.

failures per 100 track-miles, an increase of 44.8 over the rate reported in 1935 for the 1928 rollings. The failure rate for the 1929 rollings is the highest of any yearly rollings within the last 11 years with the exception of that for 1926. Both service and detected failures are included in these figures.

As in past years also, the report contained an analysis of rail failures with respect to the rollings of the different mills, and a number of tables, diagrams and charts showing trends in failure rates. The mill comparison table again shows failure rates separately between service failures and service failures plus detected failures.

AAR Detector Car—In a brief statement on the operation of the AAR detector car, Mr. Barnes reported, in part, as follows:

On November 14, 1935, the detector car completed its seventh year of operation. During this period it tested a total of 34,387 track-miles of rail. The improved detector car body and new tow car which were put in service last year have greatly improved the service rendered, reducing delays formerly occasioned by inadequate towing equipment and reducing the time required for repeat tests through the rapid acceleration and braking that are now possible.

The number of transverse fissures detected during the last year was unusually high, which indicates either improved operating efficiencies, greater prevalence of fissures, or a combination of both. The demand for service continues active.

Transverse Fissure Statistics for 1934—The report on this subject, which, as in the past, was prepared by W. C. Barnes, brought the transverse fissure situation up to date and was presented largely in tabular and chart form. Some of the more important data submitted included the total fissure failures reported each year since 1919; fissure failure rates from date rolled to December 31, 1934, by mills, with service and detected failure rates separated; and transverse fissure failures of individual roads, likewise separated as regards service or detected failures.

The statistics given constitute a cumulative record of 85,283 transverse fissure failures. The accumulated grand total of transverse fissure failures, service and detected, up to December 31, 1934, from all rollings, as compiled from roads which report regularly, was 79,305, which is an addition during the year 1934 of 9,820 on these same roads. Of these 9,820 failures, 4,786 were service and 5,034 were detected. This number of failures for 1934 represents an increase of 1,106 failures over the total reported in 1933.

Cause and Prevention of Rail Batter—The committee made a detailed study of various methods of preventing rail batter, including the heat treatment of rail ends, its studies taking in large mileages of rail distributed over various railroads where several methods of heat treatment have been used, dating back as far as 1927. In its report it did not go into the cause and prevention of batter to any extent, but, rather, confined its remarks largely to methods of determining the true condition of the rail head at the ends. It submitted an illustration of the precision profile instrument which it has been using in its investigations, and also typical graphs of rail head profiles as produced by the instrument, showing the favorable condition of heat-treated rail ends after 4½ years of traffic, as compared with the condition of untreated rail ends subject to the same traffic. It called attention to high spots immediately back of the ends of the rails which had been heat treated, and expressed doubt that these would become objectionable within the life of the rail. In any event, it pointed out that these high spots could be ground down at nominal expense.

As a result of its investigation, the committee submitted a group of conclusions, which it recommended be published in the Manual under the heading "Batter." The first two of these conclusions are as follows:

(1) Objectionable batter can be prevented by the hardening of rail ends through suitable heat treatment, with a Brinell hardness not exceeding 400.

(2) When rails are laid, the difference in surface heights of adjacent rail ends should be corrected by grinding. After heat-treating ends, and before traffic, the hardened ends should be cross ground or slotted.

The remainder of the conclusions, which was supported by illustrations of a 10-in. batter gage and two forms for recording rail batter readings, recommended by the committee, had to do largely with the proper use of the gage and forms in making and keeping accurate records of rail batter.

These conclusions were approved for publication in the Manual, with the single change, suggested by F. M. Graham (Penna.) subcommittee chairman, who presented the report, that the Brinell hardness number 400, stated in conclusion No. 1, be raised to 500.

Rail Lengths in Excess of 39 Feet—In a brief progress report, the committee stated that replies to a questionnaire sent to a number of European railways showed that all of these roads were using rails of greater length than is common in this country, ranging from 45 ft. to 98.4 ft. (30 m.). Several of these railways reported welding two to four rails together, forming continuous lengths from 98.4 ft. (30 m.) to as much as 196.8 ft. (60 m.). As the most outstanding use of long rails, however, the committee referred to the long stretches of rail on the Delaware and Hudson where individual 39-ft. rails have been welded together to form continuous rails more than a mile in length. Recognizing the economies possible in track maintenance through the elimination of the breaks between rails at rail joints, the committee proposes to continue its study to determine the maximum length to which it is feasible to roll rails and move them out into the track, and the maximum length to which it is feasible to weld the rails together in the field.

In an early issue of one of the association bulletins the committee proposes to publish the information received from foreign countries in answer to its questionnaire, together with a description of the long welded rail installations on the Delaware and Hudson.

Cause of Corrugation of Rails—Collaborating with the Mechanical Division, A. A. R., the committee studied the problem of rail corrugation at some length, giving consideration first to the exhaustive studies and tests undertaken by the American Electric Railway Association to determine the cause of rail corrugation on city and suburban electric lines. Following a brief summary of the findings and conclusions of the association as the result of its investigations, and brief comment as regards the problem of corrugations on steam roads, the committee said, in part, as follows:

The committee has studied this problem at length and is of the opinion that the many variables involved preclude the determination of a general cause of corrugations. It has not thought it advisable or even practicable, without a special appropriation, to undertake extensive tests which, at best, could be expected to determine the cause of corrugations only at a given location, and hence would not lead to a general means of prevention.

Furthermore, the committee is of the opinion that corrugations are not a serious problem on steam roads, especially since in the rare cases where corrugations are so bad as to seriously affect the riding quality of the track, they can be removed at moderate expense by grinding. The rail grinding car developed and used by the Lehigh Valley will satisfactorily remove corrugations at a cost of about $22 a mile. (This car was described in the *Railway Age* of September 1, 1934.)

The committee stated that it plans to take repeated contours of corrugated rail at identical locations over a period of years to learn more about the apparent self-limitation of growth of corrugations and the automatic smoothing out of the crests. As it is expected that no report can be made for many years, however, it recommended that this subject be discontinued. This recommendation was approved.

Other Subjects—Progress was reported by the committee in its study of the following subjects: The economic value of different sizes of rail; service tests of various types of joint bars; and the effect of different kinds of ballast on the life of rail and upon rail failures.

Complete Roadway and Track Structure

J. V. Neubert, Chairman*

The committee, formed in 1934 to study complete roadway and track structures for various loads and traffic densities, continued its investigation during the year, but made no detailed report. In fulfilling its assignment, the committee proposes to base its work largely upon the data which have been developed

* Chief Engineer Maintenance of Way, New York Central.

by several fundamental committees of the association. For several widely used or accepted rail sections, it plans eventually to develop complete track structures, giving consideration to traffic density, loads, speeds and other influencing factors.

This report was received without comment.

Shops and Locomotive Terminals

J. M. Metcalf, Chairman *

The committee reported in detail on four of its five assignments, including the revision and consolidation of all of the material now in the Manual with regard to oil houses and paint stores. It reported progress in its study of welding equipment installed in shops and locomotive terminals.

Adaptation of Engine Terminal Facilities for Handling Oil-Electric Locomotives and Rail Cars—After pointing out that the provision of facilities for the handling and repairing of oil-electric locomotives is a problem of growing importance with the increasing size of such power units as are coming into use, the committee, as a progress report, presented the results of its study of the arrangements made by one road, which has in operation four streamlined articulated three and four-car trains. The power plant in each of these trains consists of a Diesel oil engine direct-connected to an electric generator for propelling the train through two 300 hp. motors on the two axles of the leading truck.

For servicing this equipment, the road in question has provided a drop pit of ample dimensions, equipped with an electrically-operated drop pit table of sufficient capacity to handle such weight as is imposed upon it by the front end of the forward car and power truck. While the car is supported by two hand-operated overhead cranes, the power truck is lowered by means of the drop pit table and is taken out on an adjacent track and then lifted to the track level by means of an electrically-operated overhead crane.

The layout is arranged so that the train is serviced with the power truck over the drop pit, and the inspection pit extends from the drop pit to the end of the train, making the overall length of the drop pit and inspection pit the full length of the train.

Fuel oil facilities, consisting of an underground storage tank with fuel oil capacity for 30 days' supply, have been provided, together with an oil unloading device, fuel oil pump and the necessary hose connections for filling the storage tanks mounted beneath the cars.

A tank for collecting condensate from the coach yard heating system, together with an electrically-driven pump, is provided so that water for the train heating boiler can be pumped into the train storage tanks, thereby supplying distilled water to the train heating plant.

Power Plants—The work of the committee on this subject for the year was confined to the study of major power plants at railroad terminals generating steam for all local demands, except for producing electric power; electric power being obtained from outside sources. In its report, which first discussed the proper location of terminal power plants, the committee said, in part, as follows:

The steam generating plant usually consists of a sufficient number of boilers for the present demands and space for such additional facilities as may be needed for the future expansion of the local terminal and shops. Where the fuel is coal, boilers should be stoker-fired, employing traveling grates for free-burning coal, or retort type for coking coal; the coal to be handled by machinery, elevators and conveyors from track hoppers where cars can be unloaded with the least expense. Ashes should be handled by machinery (chain conveyor, steam or vacuum systems) and be made to discharge into a receiving hopper or directly into cars. The boiler room should be equipped with modern appliances to check performance and for economic operation.

The economic production of steam and power from fuels is controlled by three fundamental factors: First, the fuels themselves and their characteristics; second, the plant equipment by which the energy latent in the fuel is transferred to steam; and third, the manner in which this operation is carried on.

These factors, while varying for different plants and different fuels, are closely interrelated, plant operation being controlled not only by the skill of the operating force, but by the limitations of the equipment and the characteristics of the fuel used.

The selection from the fuels commercially available to any particular plant, of the one that will produce steam most economically, considering both price and usability, is the first and most important single factor in the economy of plant production. The efficient utilization in the plant of the fuel selected is, however, of vital importance also, and it is only by proper fuel selection, seconded by proper utilization, that the maximum economy in steam production can be obtained.

Following a detailed discussion of the various types of fuels commonly used in power plants, and of the relative importance and availability of such fuels, the committee called attention to a number of other factors which have had a favorable influence on steam power plant economy, these factors including improvement in furnace design and fuel handling and burning equipment; higher boiler pressures and temperatures; cleaner feed water and higher feed water temperatures; better boiler maintenance; and the more careful check being kept on plant performance.

On the subject of power plant design, the committee pointed out that the objectives to be sought in a power plant are reliability of operation and an economical product, whether that product is steam, electricity or mechanical power. In other words, it said, the plant must be dependable and commercially efficient to justify the investment. At the close of its discussion of this subject, in which it enumerated the more important facts which should be taken into consideration in power plant design, the committee said that the question of the type of power plant which is best can never be answered twice in the same way. What is "meat" for one plant, it pointed out, might be "poison" for a dozen others.

Car Wheel Shops—Rather than present an abstract discussion of this subject, the committee thought it more effective and valuable to present a study of a recently constructed, up-to-date shop, showing how the problems of layout and design were worked out to meet the specific conditions existing. Accordingly, it presented as its report a brief description of the modern freight car shop layout of the Chesapeake & Ohio at Russell, Ky. (described in the *Railway Age* of August 29, 1931), together with an outline of the method of operation at these shops. With the report, it included a plan of the Russell shop layout, showing the location of the car wheel shop with relation to the other facilities, and also a plan of the wheel shop itself with its machinery and equipment.

Revision of the Manual—The committee gave detailed consideration to the separated material in the Manual with regard to oil houses and paint stores. As a result, it presented a revision and consolidation of the material on these subjects in the 1929 Manual, pages 274 and 275, and 1486 and 1487, which had been included at different times independently by the Committee on Shops and Locomotive Terminals, and the Committee on Buildings.

The revised material was adopted.

Report on Signals and Interlocking

C. H. Tillett, Chairman *

As in recent years, the committee presented its report under the two main heads—Developments in Railway Signaling, and Principal Current Activities of the Signal Section, A.A.R.

Developments in Railway Signaling—Under this assignment, the committee discussed only coded signal line and rail circuits. Its report follows in full.

Coded signal line and rail circuits embrace a system of operating signal line and rail circuits by means of coded or interrupted current, as distinguished from the steady or continuous current formerly in use. This system was first installed in 1926 with continuous train control and cab signaling.

Coded line and rail circuits may be applied in either steam or electric propulsion territory; where either wayside or cab signals are used, or where both wayside and cab signals are used. It may be applied where two-block three-indication signaling, three-block four-indication signaling, or four-block five-indica-

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* Signal Engineer, Canadian National.

tion signaling is used, or it may be applied where the energy fed to the track circuit is direct current, alternating current, or both, or where frequency selective track relays have been required.

The coded line and rail circuits have many advantages, some of which are as follows: (1) Coded energy in either track or line circuits provides increased immunity to false energization from crosses, grounds or any other foreign influence; (2) it increases track shunting sensitivity; and (3) it provides three or four-block wayside or cab-signal control without the use of line wires, eliminating pole line or duct line signal control failures.

Current Activities of Signal Section, A.A.R.—This section of the report included a synopsis of the principal activities of the Signal section from November, 1934, to November, 1935, including 23 items. In addition, it listed the specifications, drawings, requisites, forms, instructions and tables revised; the new specifications, drawings, instructions, forms and conclusions prepared; the new reference data and miscellaneous matter recommended for inclusion in the Manual; and the specifications, drawings and miscellaneous matter to be removed from the Manual.

This report was accepted without comment.

Water Service, Fire Protection and Sanitation

R. C. Bardwell, Chairman *

The committee reported progress in the study of all of its ten assignments, but made detailed reports on only four. A large part of its attention during the year was given to a complete review of all of its material in the Manual.

Revision of the Manual—In view of the proposed reissue of the Manual, the Committee made a review of all material of direct interest to it in the 1929 Manual and supplements, and recommended a number of revisions, deletions and additions. The most extensive changes were made in material appearing under the following heads (in many cases complete substitutions were made): Pumping plants—buildings; deep well equipment; centrifugal pumps; specifications for cast iron pipe and special castings; specifications for hydrants and valves; specifications for soda ash for water treatment; specifications for hydrated lime; specifications for quicklime; specifications for sulphate of alumina; specifications for sulphate of iron; minimum quantity of scaling and corrosive matter which will justify water treatment; foaming and priming; and water service records.

In addition to these more extensive changes, the committee recommended lesser changes under 12 other heads and the deletion of 82 definitions. The committee also recommended the addition of 9 definitions, and material under two headings: Sewage Disposal Where Sanitary Facilities are not Available, and Disinfectants, Deodorants, Fumigants and Cleaning Materials.

These revisions of the Manual were approved without discussion.

Pitting and Corrosion of Locomotive Boiler Tubes and Sheets—In a report submitted as final, the committee gave primary attention to the subjects of locomotive washout periods and the conditioning of water in boilers by systematic blowing. In the introduction to its report, the commitee said:

Operation of steam locomotives over extended washout periods has been demonstrated to be practical and economical under general water conditions found throughout the country. Some roads have operated on this basis for a number of years, while other roads have recently adopted the practice of washing locomotive boilers only at monthly inspection time. Of 19 roads giving information on this subject, 8 are operating the full 30-day period permitted by law between washouts; 5 are operating part of their locomotives on this basis; and 6 are making no efforts along this line. No road has been reported which, having once established its locomotive operation on the extended washout basis, has returned to more frequent boiler washing.

A number of factors have united during the last few years to bring this subject to the attention of railroad managements, and considerable interest is manifest on many roads that still operate with the frequent washout and water change practice. With greater investment in larger and more powerful locomotives, it becomes desirable to keep the locomotives in active service as much as possible; the extension of locomotive runs makes it necessary that the water in the boiler be conditioned without taking the locomotive out of service for boiler washing; and decreased revenues during the depression have centered attention on possible sources of economy, both in operation and in maintenance.

In the body of its report, the committee discussed adverse boiler conditions produced by water; the conditioning of water in boilers by systematic blowing; fuel losses from blowing; the use of hard, or scale-forming waters; mud and sludge conditions; alkali salts; equipment for blowing boilers; supervision required; and objections to and benefits from blowing. The committee said:

There are found to be some objections to the blowing of boilers. This is particularly true when the system of operation is first instituted on the road. Some men object to any change from established practice. If a thing is new they will try to discredit it. Switch stands have been blown down, blow-off valves have been opened so that buildings have been damaged and passenger equipment rendered dirty and unsightly. Some have claimed that discharging the water from boilers on ties and bridge timbers causes them to rot rapidly. This has not yet been substantiated and there is good reason to believe that the claim is not well founded. Claims have been made also that frequent discharge of boiler water salines on the roadbed produces a condition that shunts and short-circuits signal currents, causing interruption of correct signal indications. While it is possible that this condition is produced, it has not been clearly and definitely established. However, both of these conditions can be eliminated readily by placing the centrifugal separator on top of the boiler and discharging the water outside the track.

The benefits from blowing boilers and operating with extended washout periods are many and definite. Probably the first benefit is the decrease in engine failures and train delays on account of foaming. This trouble is practically eliminated when terminal and road blowing are properly done. If some abnormal and emergency water condition develops that would normally cause a boiler to foam, the engine crew increases the blowing sufficiently to take care of the situation and the train operates without delay. This improvement in operation is an intangible item, but it is of very definite benefit. There is a decrease in the cost of terminal engine handling ranging from 25 cents to 50 cents per engine handled. Engines are turned more quickly, keeping them in more nearly continuous service. Fewer engines are required to handle the business at hand, meaning that a smaller number of engines has to be maintained for service.

The greatest tangible saving comes from decreased boiler maintenance costs. Every time a hot boiler is emptied, the sheets, staybolts and flues cool rapidly. Even though hot water is used for washing and filling, it is cold to the boiler metal with its temperatures of only 250 to 300 deg. F. The rapid cooling of the metal is accompanied by rapid contraction and excessive stresses. There is a corresponding expansion, though slower, when the boiler is reheated. Frequent repetition of this cycle soon produces cracks in flue sheet knuckles and in side sheets, and breaks staybolts. One road that formerly had flue-sheet knuckles cracking in five to six months now runs the same engines in the same service for more than twice as long per knuckle patch. Side sheets that formerly cracked in 10 to 14 months have had no cracks in the last three years. Another road has a record of less than one broken staybolt per engine per year. One road made a saving in roundhouse boiler maintenance alone of more than $100,000 per year since adopting the operating of boilers on the extended wash-out period.

The committee offered the following by way of summarizing its findings:

Boiler washing does not prevent: (1) Scale formation; (2) corrosion; (3) development of leaks.

Boiler washing can prevent: (1) Mud accumulation; (2) foaming.

Boiler blowing can prevent: (1) Mud accumulation; (2) foaming.

Boiler blowing produces: (1) Extended washout periods; (2) improvement in train operation; (3) decreased scale formation in boilers; (4) decreased boiler leaking conditions; (5) decreased number of cracked sheets and broken bolts; (6) decreased terminal handling costs; (7) improved road fuel per-

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formance; and (8) greatly decreased boiler maintenance costs.

The following conclusions were presented by the committee:

(1) The presence of excessive amounts of mud and the deposition of scale of sufficient thickness to require bombardment of sheets for removal are the only water conditions that affect the period between boiler washouts, providing the boilers are properly blown and handled.

(2) Operation of steam locomotives over extended washout periods by proper use of the blow-off valves is practical and produces large economies for the roads that use this method for conditioning water in boilers.

D. A. Steel (*Railway Age*) praised this part of the report as a notable contribution to information on one of the most commanding developments in railway boiler feed water progress. However, while commending the efforts being made to control feed water by more blowing down on the road, he mentioned the element of danger inherent in locomotive operation and the heavy responsibility resting upon railroads to avoid explosions and other locomotive accidents which might be attributed to water conditions and cautioned against overenthusiasm in reducing boiler washing and water changing at terminals. He emphasized the fact that boiler washing is not only intended to remove loose scale and deposits which are not removed by blowing down but that it also permits a visual inspection of the boiler interior. This opportunity for inspection and the further assurance of clean boilers afforded by boiler washing, he stated, should not be reduced unduly until water forces can be sure under all conditions that their water practices and blowing down will definitely and invariably relieve the locomotive forces from their responsibility for safe as well as economical performance.

Types of Lime and Soda Ash Treating Equipment—In a final report, the committee presented an historical review of the lime and soda ash method of water treatment, which it pointed out is the oldest form of treatment, having been first used in Scotland in 1840. At the present time, it said, continuous plants of this type of treatment in railway service have capacities from 12,000 to 150,000 gal. per hour, with settling tanks of diameters ranging from 12 ft. to 62 ft., and heights suitable to meet service requirements.

Following this more general material, the report included a brief discussion of the various types of chemical mixing, control and proportioning equipment, and ended with the following conclusions:

(1) The mechanical device for introducing reagents must be such as to insure as near as possible a quantity of reagent in direct proportion to the flow of untreated water.

(2) The type of equipment for such installations can best be determined by a careful study of all local conditions, giving consideration to annual operation and maintenance charges.

Other Subjects—Other subjects studied by the committee during the year include the following: The relation of railway fire protection equipment to municipal and privately owned waterworks; the use of phosphates in water treatment; the value of water treatment with respect to esimating and summarizing possible savings effected; methods for analysis of chemicals used in water service; progress being made by federal and state authorities on regulations pertaining to railway sanitation; and clarification and disinfection of small railway drinking water supplies.

Report of Committee on Electricity

J. V. B. Duer, Chairman *

In fulfilling its assignment to keep the association informed of developments in the application of electricity to railway service, the committee presented a brief summary of the more important reports prepared by the different committees of the Electrical section, A.A.R., and published in an Electrical Section Bulletin dated December 27, 1935. In this summary it gave major attention to the report of the Committee on Power Supply, calling attention particularly to the material presented with regard to central power station development; power production in the country; the servicing of car air-conditioning equipment; the Federal Power Commission's "National Power Survey"; the use of Diesel power in railway service; and railway electrification. Other reports commented on briefly had to do with clearances, illumination, the application of corrosion-resisting materials to railway electrical construction, and a bibliography on the application of electricity to railways.

This report, which was received without discussion, was presented by Vice-Chairman G. I. Wright, chief electrical engineer, Reading, in the absence of Mr. Duer.

*Chief Electrical Engineer, Pennsylvania.

Maintenance of Way Work Equipment

C. R. Knowles, Chairman *

Although actively engaged during the year in the study of all of its 13 subject assignments, the committee made detailed reports on only 6, reporting progress on the other 7 assignments. For various reasons it recommended that the study of 4 of its assignments be discontinued.

Revision of the Manual—The committee recommended that 75 definitions appearing in the Manual be eliminated. It also recommended removal from the Manual of Exhibits 2 and 4, opposite page 1468, Motor Car Operator's and Maintainer's Monthly Form, and Roadway Motor Car Service and Maintenance Cost Report; and of Paragraphs 1, 2 and 3, with regard to the economics of brush versus spray painting, Bulletin 347, page 70. With the approval of the Committee on Economics of Railway Labor, the committee reported also that it had taken under its jurisdiction certain material in the Manual with regard to motor car axles and wheels, and the maintenance of motor cars, which it proposes to revise for reinclusion in the Manual.

These revisions were approved.

Standardization of Parts and Accessories for Motor Cars—The study of the committee during the year centered mainly around the standardization of wheels and axles. Careful consideration was given to the material now in the Manual, Bulletin 327, pages 87 and 88, with regard to axles and wheel treads, which the committee said was incomplete in many details and did not provide for the interchangeability of parts.

In its report, the committee first discussed the most desirable contour of wheel flanges and treads, tolerances in the diameter of wheels, length of axles and thickness of insulation, and in all of these matters found general agreement of thought among its members. However, it refrained from presenting revised plans until the views of manufacturers have been received and considered. It then presented a brief discussion of wheel and car frame construction, concerning which it felt that no recommendation of standard practice can be made.

Track Grinders—The committee presented a comprehensive review of the development of track grinders, discussing in order of development or refinement the different units put on the market by the Stow Manufacturing Company, the Nordberg Manufacturing Company, the Railway Trackwork Company, Cyril A. Fox, the Mall Tool Company, the Ingersoll-Rand Company, the Keystone Grinder Company, the Northwestern Motor Company and others. The principal types of grinders discussed include the various types of rail surface grinders (wheel and reciprocating), side flow grinders and cross grinders. Reference was also made to the large special grinding car developed by the Lehigh Valley for removing corrugations from the running surface of rails.

The committee found it impossible to prepare specifications for grinding wheels in view of the many variables encountered in present-day wheels, especially in the abrasives and in the bonding materials used. Summing up its discussion of this subject, the committee made the following comments:

What we want is a wheel that will cut freely and yet will not wear out too fast. Some wheels will do ten times as much grinding as others costing more and wearing out sooner. Our only suggestion is to explain to reputable manufacturers the kind of grinding to be done and the type of machine to be used, and then leave it to their judgment and experience to recommend the best wheel. When other makes are offered, try them and decide which does the most work for the least total expense. The committee recommended that this subject be discontinued for the present.

As a part of its report, the committee presented a group of instructions for the use and care of abrasive grinding wheels,

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based on the American Engineering Standards Safety Code for the use, care and protection of abrasive wheels. These instructions include 21 items with regard to general practice, storage, inspection, speed of grinding wheel, application, starting new grinding wheels, grinding operation and wheel breakage.

Selection and Training of Maintainers and Operators of Work Equipment—After pointing out that the railways now have approximately $100,000,000 invested in construction and maintenance of way work equipment; the importance of maximum utilization of this equipment; and the equal importance of the proper operation, maintenance and repair of this equipment, the committee showed the importance of having at all times well trained operators and maintainers in charge of all units if the maximum return is to be secured from them. It then discussed in detail the selection and training of maintainers and operators, and presented the following conclusions:

The extent of the investment of the railways in roadway work equipment requires the establishment of systematic methods for protecting that investment, and for securing the maximum return on the money involved. It is our recommendation that:

(1) Proper care be given to the selection of prospective operators.

(2) That the appointment of an operator should be preceded by placing him with an experienced operator for a period of training. During the training period, he should study that portion of the Manual of Instructions that pertains to the particular machine to which he is assigned until his qualifications are proved by means of an examination by the maintainer.

(3) That division and other officers directly responsible for the use of work equipment thoroughly familiarize themselves with the contents of the Manual of Instructions in order that they may properly supervise compliance with the rules.

These three recommendations were approved.

Manual of Instructions—Drawing upon the individual experience of many men, railroads and equipment manufacturers, the committee prepared and presented for the benefit of operators, foremen, master carpenters, supervisors, division engineers and other officers or employees interested, a comprehensive manual of instructions covering the operation, performance and maintenance of machinery used in maintenance of way work. So far as machine operators are concerned, the instructions themselves point out that the manual was prepared, not with the idea of instructing them how to assemble or disassemble the major units of any piece of equipment, but rather to help them take the best care of the equipment as a whole and to so operate it as to obtain the maximum service from it with the minimum of maintenance expense. The complete manual includes 325 items of instruction, dealing with general conduct and duties, and the "do's and "dont's" in connection with the operation, maintenance and repair of a wide variety of extensively used machines and power tools.

The committee recommended that further study of this subject be discontinued for the present.

This recommendation was accepted.

Concrete Mixing and Handling Machinery—The committee pointed out that most large railroad projects requiring the mixing and pouring of large amounts of concrete are handled by contractors who furnish their own mixing and handling equipment, but, because of the large amount of other work performed by the maintenance of way and construction forces involving the mixing and pouring of concrete, it felt that it was important for those involved in such work to have a general working knowledge of this equipment in order to determine the most effective and economical units to use under any particular conditions. As the main part of its report, therefore, it presented a description of the various type of equipment available and outlined the general classes of work for which it is best adapted. In addition to mixers, this descriptive material included such placing equipment as concrete barrows, carts, cars and trucks; concrete placing towers, elevating equipment and chutes; and concrete placing trestles with their auxiliary cars, hoppers, chutes, etc. As a result of its study, the committee arrived at the following conclusions:

The past and future design of concrete mixing and handling machinery has been and well be influenced by the requirements of contractors to a far greater extent than by the requirements of railroads. This is because most of the mixing and handling machinery in use, even on railroad jobs, is owned and operated by contractors.

There are available today sufficient kinds or types of such machinery to suit all railway requirements.

In view of the great influence of local conditions on the kind of equipment used, it is considered inadvisable to make definite recommendations regarding concrete mixing and handling machinery for railroad service.

Other Subjects—The committee reported progress in the study of the following subjects: Electric tie tampers; use and adaptability of crawler-type tractors in maintenance of way work; methods of keeping data on work equipment; machines for laying rail, and their auxiliary equipment; track welding equipment, oxy-acetylene and electric arc; power bolt tighteners; and power saws. It recommended that the assignment with regard to methods of keeping data on work equipment be discontinued for the present.

Report on Standardization

E. M. Hastings, Chairman *

The outstanding work of the committee for the year was the formulation of a list of A.R.E.A. recommended practices which the several committees of the association agree should be advocated for general use on the railways, and the forming of closer ties of co-operation between the A.R.E.A. and the various committees of the American Society for Testing Materials. In addition, the committee maintained its contacts with other bodies interested in the advancement of standardization, and reported on the principal activities during 1935 of the American Standards Association and the Canadian Engineering Standards Association.

A.R.E.A. Recommended Practices Advocated for General Use—In fulfilling its assignment to ascertain what A.R.E.A. recommended practices should be advocated for general use on the railways, the committee devoted much study to the subject and arranged for each standing and special committee of the association to select those of its recommendations which had been adopted by the association, for consideration for uniform practice on all roads. The suggestions received from the various committees were carefully reviewed by the Committee on Standardization, and from the many items presented, a number were selected as worthy of consideration for adoption as uniform practice on all railways in the interest of efficiency and economy. These selected items, more than 120 in number, were listed under the specific committees interested, and were presented as Appendix A of the committee's report.

Contact With Standardization Bodies—Following a meeting of the committee with representatives of the American Society for Testing Materials in Philadelphia, Pa., on May 6, the purpose of which was to bring about closer co-operation between the A.R.E.A. and that society, the committee recommended that the president and board of direction of the A.R.E.A. authorize the formal appointment of members from A.R.E.A. committees for co-operative and contact work with certain A.S.T.M. committees. This recommendation was acted upon favorably and, as a part of its report, the committee presented the names of the 25 co-operators appointed. The A.S.T.M. was reported as very desirous of this arrangement for maintaining closer relationship between the two bodies.

American Standards Association—In a brief report with regard to the activities of the A.S.A., the committee described the recent important change in the association's organization, providing for the departmentalization of its work into industrial groups, each having a divisional committee at its head.

The new arrangement provides for each divisional committee to carry the name of the major industry from which its members are selected, and for the grouping of the sectional committees doing the technical work under the divisional committees of the industries with which their work is chiefly concerned, with proper collaboration between the committees of the various groups which may have a common interest in some elements of their work. In these respects the organization is similar to the arrangement for committee work in the A.R.E.A, although most of the A.S.A. divisional committees have not yet been created.

As appendices to its report, the committee presented a list of

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standards approved by the American Standards Association during the period from September 1, 1934, to September 1, 1935, and a list of the A.S.A. technical projects on which the Association of American Railroads is now co-operating.

The report was accepted without comment.

Report of Committee on Ties

John Foley, Chairman *

Continuing its work for another year, the committee gave consideration to nine subjects, presenting reports on four. A feature of its report was the specification for machining crossties.

Specifications for Pre-adzing and Pre-boring Crossties—In view of the large amount of machining of crossties before treatment which is now being done by many roads, including such items of work as grooving, incising, trimming and branding, in addition to pre-adzing and pre-boring, the committee thought it desirable to make available to the railways recommended standard requirements for all of these different classes of work on ties. Therefore, enlarging the field of its assignment, it prepared and submitted for adoption and inclusion in the Manual, comprehensive specifications for the machining of crossties. These specifications cover adzing, grooving, boring, incising, trimming and branding.

G. H. Tinker (N. Y. C. & St. L.) objected to the use of the term "machining" as not being applicable to the processes of adzing, boring, grooving, incising, trimming and branding to which the ties are subjected. Mr. Foley replied that the committee had discussed a number of terms but had found no other which is so nearly descriptive of the operations to which the ties are subjected. The specification was then adopted without further discussion.

Adherence to Specifications—The committee made observation during the year of nine wood preserving plants and more than 3,000,000 crossties at scattered points in the central and upper Mississippi valley. All of the plants observed, except one owned by a railroad, were commercially operated. Reporting on its findings, the committee said:

The condition of storage yards, stacking of ties, etc., at most of the plants was to be commended. At one commercial plant and at the one railroad plant conditions could be materially improved. Drainage was not good, weeds were allowed to grow, bark, chips and other rubbish were allowed to accumulate and ties were poorly stacked and cared for. Workmanship in manufacture of ties continued to show an improvement, but in some places lack of practice in hewing was in evidence, especially in trimming and the removal of branches and knots.

While the standard of inspection on the railroads under observation was not always of the highest, improvement was noted in certain cases. On some roads inspection was uniform and beyond reasonable criticism. Generally, the ties accepted conformed to the standard dimensions, although in some cases wane apparently is overlooked in sizing ties. The greatest laxity in inspection was in the acceptance of ties containing decay and shake.

With respect to the importance of uniform and correct inspection of ties, the committee presented the following paragraph from the Report on Technical Improvements in Railroad Equipment, Roadway and Structures, by the Section of Purchases, Federal Co-ordinator of Railroads:

"The question of tie specifications has been studied in some detail in connection with purchasing problems. Our present conclusion is that existing specifications for the different varieties of ties are well drawn, and if closely followed would enable the railroads to secure full value per dollar expended. The fact is, however, that the specifications are not followed to the extent which is desirable and possible. The most important factor in this situation is that of inspection. Methods of inspection vary widely because of differences in inspectors as to knowledge, experience, and attitude toward vendors. In many cases disputes arise between vendor and purchaser, the vendor claiming to have been injured by reason of improper or inefficient inspection. Similar disputes arise between the engineering and purchasing departments of railroads."

The committee stated that, in its opinion, the universal use of the A.R.E.A. specification in the procurement of ties and the uniform application of its provisions in their inspection will eliminate the difficulties referred to above. It pointed out that it is attempting to gain competitive advantage in obtaining ties through departures from the standards which give rise to disputes, and said that all proposals to lower the adequacy of the requirements for assuring satisfactory ties are predicated on accommodating the specification or the inspection or both to prices.

Tie Renewal Averages and Costs per Mile—To meet the desires of the railways for early publication of the facts and figures brought together yearly by the committee with regard to tie renewals and tie costs, the committee issued its report on this subject in Bulletin 376 (abstracted in the *Railway Age* of September 7, 1935). As in past years, the report included tables of tie renewals and costs for the leading roads of the United States and Canada, the data with regard to the roads in the United States being taken from reports made to the Interstate Commerce Commission.

Substitute Ties—In view of the demands being made on the railways for various data, and because of the fact that no new types of ties had been brought to its attention, the committee during the last year did not send out its usual questionnaire regarding substitutes for wood ties. As a result, it made no report on this subject.

Revision of the Manual—The committee recommended two minor revisions in its Manual material, one having to do with anti-splitting irons, and the other with regard to the period of storage of ties.

These revisions were approved.

Other Subjects—Other subjects given consideration by the committee during the year were as follows: The proper seasoning of oak ties, with special reference to those grown in southern lowlands; best practice from the manufacture of the tie to its installation in the track; and the effect of different kinds of ballast on tie life.

Economics of Railway Location

F. R. Layng, Chairman, *

Two of the four assignments of the committee were reported on in considerable detail, while progress was reported in connection with the other two assignments.

Operating Data Essential to Establish Units for Analyzing Line and Grade Revisions—In a detailed report on this subject, the committee, in chronological order, carefully developed all of the factors and units which should be taken into consideration when determining whether line and grade revisions are economically feasible in view of present and prospective operating requirements. After discussing the various units involved in making studies of line and grade revisions, the committee pointed out the necessary preliminary studies and conclusions that must precede any adequate determination of whether a proposed line and grade revision project is justifiable, and then discussed at some length the development of freight traffic and service units.

When comparing the costs of operating over an existing line with the costs of operating over the same line with improved alinement and grade, the committee cautioned that it is first necessary to develop the full possibilities of the existing line in order to make an equitable comparison with the full possibilities of the revised line. In this regard, it said as follows:

It is not safe to assume that the number of service units actually employed on an existing line is the least number consistent with limiting grades and other physical limitations. Therefore, the following tests should be made:

(1) Compare the actual average train load with the capacity of the average locomotive. Find by analysis and further investigation the reason for the difference. This investigation will show either (a) that the service units may be reduced before making comparison with a proposed new line, or (b) that there are limitations other than grades that may similarly affect the number of service units of the proposed new line.

(2) Determine the speed in miles per hour by dividing train-miles by train-hours for each class of service. Tabulate delays with respect to causes and also with respect to the places where they occur and reach definite concluions as to the underlying causes. This investigation will show either (a) that the train

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speed on the existing line may be increased before making comparison with the proposed new line, or (b) that conditions exist which may affect the train speed over the proposed new line.

(3) Investigate the following data for locomotives in service: Age, average tractive power, coal and water capacity, modern appliances and engine failures.

(4) Investigate the following items as to their effect on train speed: (a) Condition of track and bridges; (b) adequacy of main and running tracks and sidings; (c) location and adequacy of coal and water stations; (d) suitability and conditions of train dispatching facilities; (e) adequacy and efficiency of fixed signals; (f) interference at intermediate yards; (g) operating practices with respect to picking up and setting off cars or filling out or reducing at intermediate points; and (h) efficiency of operating methods and personnel.

Completion of these studies will probably show that changes in physical conditions other than revision of line and grade are practical at reasonable expense and would reduce the number of service units in present operation. If so, the statement of present service units which is to be the basis of further calculations should be appropriately modified so that the comparisons finally developed will be an accurate measure of the difference in service units flowing from the change to be made in the line and grade.

Following this part of its report, the committee discussed the determination of train loads and train speeds for a revised line, and also the determination of the number of service units required for the volume of traffic to be handled. It then analyzed in detail the determination of operating and maintenance costs over a revised line as compared with an existing line, giving particular attention to wages of enginemen and trainmen; enginehouse expenses; expenditures for fuel, water, lubricants and other supplies; locomotive repairs; car repairs (per diem); expenditures for maintenance of way and structures; interest; depreciation; insurance and taxes.

Effects of Speeds in Excess of 75 M.P.H. on the Economics of Railway Location—In a relatively short yet comprehensive report, the committee, after making acknowledgment of the benefits of higher passenger train speeds in recovering for the railways some of their lost passenger business, gave detailed attention to the various factors which normally mitigate against high speed travel by rail, discussing separately, grades, curvature, roadbed and track, and the location of signals and passing sidings. As regards roadbed, track and signaling, the committee made the following comments:

Any irregularities in line and surface of the track become more pronounced as speed increases. The impact caused by such irregularities increases rapidly with speed. The adverse effect on the track structure of the lower center of gravity of certain of the newer high speed train units must also be considered. The high speeds under discussion demand the highest standards of track construction and maintenance.

On some of the roads where the maximum speed of passenger trains has been materially increased, it has been found necessary to change the location of signals. Signal location involves the question of braking distances. With different maximum speeds for freight and passenger service, the location of signals to produce the most economical operation will demand considerable study.

In discussing maximum and average speeds of trains, the committee had the following to say:

The fastest trains today have an average speed between 70 per cent and 80 per cent of the rated maximum. The average train schedule speed scarcely exceeds 60 per cent of the maximum. This low average speed is due to stops and to restrictions which require slowdowns. The elimination of such slowdowns and stops as can be avoided is an economical method of increasing average train speeds. Material increases in average speed have been accomplished on several roads by the elimination of slowdowns and stops, and this feature should be investigated thoroughly before making expenditures for grade and curvature revisions or for the purchase of new equipment. It may be found that average speeds can be increased to those desired without grade or curvature revision or change in equipment.

In discussing the economic justification of high speeds, in closing its report, the committee made the following comments:

The foregoing discussion shows that many expenditures may be necessary to obtain speeds in excess of 75 m.p.h. It is imperative that all such expenditures be included in any study of costs, together with the net effect of such service on transportation expenses.

At present there is a lack of definite data showing equipment repair costs for internal combustion motive power operated at speeds in excess of 75 m.p.h. due to the limited time such equipment has been in service.

The necessary changes in grade, alinement, and roadway and track structure will depend upon the individual characteristics of the section of road on which trains are operated at speeds in excess of 75 m.p.h.

Other Subjects—The committee reported progress on revision of the Manual, and on its assignment to review the reports made heretofore on the economics of grade revision as affected by electric operation, collaborating with the Electrical section.

The report was accepted without discussion.

Economics of Railway Operation

J. E. Teal, Chairman *

In the absence of Mr. Teal, this report was presented by Vice-Chairman M. F. Mannion, office assistant to chief engineer, Bessemer & Lake Erie.

Only three assignments were reported on in detail by the committee, but it advised that much valuable data have been accumulated and much important work has been done in connection with its six other assignments.

Effect of Volume of Traffic on Operating Expenses—Studying this assignment from the more specific standpoint of the influence of traffic density on transportation expenses, the committee made the following statement concerning its work:

The extent to which transportation expenses are influenced by changes in traffic density has been studied for each district of the United States for the years 1928 to 1932, inclusive. As an aid to judgment, the expenses for each of the principal primary accounts were analyzed graphically, and for this purpose prices and wages were adjusted to a uniform basis as of 1926, and the total gross ton miles, passenger and freight, including engines and tenders, was used as the basis of traffic density. The actual transportation expenses, i.e., the gross total for each year was used; transportation for investment credit was not deducted. The characteristics of each account, as determined by analysis, were combined by assigning to each a weight proportionate to its percentage of the total of transportation expenses. Since a distinct variation was found in the general characteristics of each district of the United States, it was deemed advisable to present the results of the analysis of each district separately.

Since the committee found a distinct variation in the general characteristics of each district of the United States, it deemed it advisable to study and to present the results for each district separately. This was done, and the results were presented in a group of tables which, for the different districts, show the extent to which each main primary account is variable with different traffic densities, and also the weighted average for the entire transportation account. Through the use of these tables, therefore, it is possible to estimate the influence of a change in traffic density upon the transportation expenses of a railway. In commenting upon the use of the tables, the committee made the following statement:

The method may be used to determine the expense either under conditions of increased or decreased traffic as compared with the base period, but it should be used with caution. For example, it cannot be expected to yield consistent results either in the case of a small property or in the case of sudden temporary changes in traffic density, nor should it be applied to a condition where the ability of the line to carry the indicated traffic is in question.

Operation With Reduced Number of Tracks—As the result of continued study of the effect upon roadway maintenance and operating costs of the conversion of double track to single track, the committee presented comparative studies of two actual cases for which cost figures were available. One of these had to do with a 32-mile double-track line converted to single track in February, 1933, and the other with a 28-mile double-track line converted to single track in December, 1932. The summary of the study with regard to the 32-mile line shows that, on the

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basis of present-day costs, the change to single track results in a total annual reduction in maintenance and operating costs of $31,310 on the cash expenditure for the change of $14,460, or 217 per cent of the cash expenditure. On the basis of normal maintenance, the change resulted in a total annual reduction in maintenance and operating costs of $52,770 on the cash expenditure of $14,460, or 365 per cent of the cash expenditure. More or less comparable savings for single track operation were shown for the 28-mile line change.

In addition to making its study on the basis of the present volume of traffic, the committee considered the ability and economy of handling a future increase in traffic on the single-tracked sections of line. This phase of the study, it said, revealed that traffic equal to the heaviest traffic in recent years (1921-1931), could be handled more economically with single-track operation and improved signal facilities, such as automatic block or C.T.C., than with double-track operation.

As the result of its studies, the committee offered the following conclusions:

Where the volume and distribution of traffic on double track has decreased to such an extent that the expense of double-track operation cannot be justified, the economic advantage of converting all or a portion of the double track to single track should be considered. Furthermore, when consideration is given to the progress which has been made in handling increased traffic by modern signal facilities, the economy in maintenance, and the safety of operation, the necessity for ever having to return to double track for the efficient operation of trains becomes remote.

Revision of the Manual—Seven subjects appearing in the Manual were reviewed critically during the year. As a result, the committee recommended deletion of the formula or method for calculating the cost of moving freight traffic, on page 1403, and the notes in connection with the formula for determining the comparative economies of flat and hump switching, page 1443. Completely revised material was submitted for substitution for the material beginning on page 1421, with regard to the method for the determination of proper allowances for maintenance of way expense due to increased use and increased investment, and likewise for substitution for the material beginning on page 1435, with regard to the starting and stopping of trains. No change was recommended in the following subjects reviewed: Feasibility and economy of through routing of solid trains and its effect upon the capacity of terminals; operation of trains against the current of traffic on multiple track; and comparative freight train performance charts. These recommendations were adopted without discussion.

Other Subjects—Progress was reported in connection with the following assignments: Methods for obtaining a more intensive use of existing facilities, with particular reference to securing increased carrying capacity; method or formula for the solution of special problems relating to more economical and efficient railway operation; analyses to determine when a railway or branch line should be retired; methods for determining the most economical train length, considering all factors entering into transportation costs; train resistance as affected by weights of rail; and the economic limits of the movement by the railway of freight from shipper to receiver—by rail, by highway, or by a combination of both.

Report on Stresses in Track

Dr. A. N. Talbot, Chairman*

During the year, the committee, co-operating with the American Society of Civil Engineers and with the Association of American Railroads, continued its study and tests of a number of matters relating to railroad track, giving attention to the action of rail joints in track, methods of design and ways of judging the merits of joint bars of any particular cross section, certain patent claims and their relation to the design of joint bars of the angle bar type for the lighter rail sections, and the various elements entering into tie plate design. No report was made on any of these subjects, however.

Tests were made during the year on three long stretches of welded rail on the Delaware and Hudson, one of these stretches being nearly a mile in length, and another nearly a mile and a quarter in length. The purpose of these tests, the committee pointed out, was to learn what anchorage is given by the ties and ballast within these installations, and at the ends of the installations, to resist the forces set up by change in temperature of the rail. The committee was also interested to learn how the influences tending to change the length and alinement of the track are met, and to ascertain whether other steps need be taken to resist these influences and other forces developed by temperature changes.

A further important project undertaken by the committee is the preparation of a general resumé of the results of its work during past years, with a summary of all of its findings.

Viewing the future, the committee proposes to continue its work in accordance with the general program which it has laid down, this program including, in addition to the subjects already mentioned, such subjects as proper super-elevations and easements for curves for high speed operation, the wear and maintenance of rail joints in track, and many matters with regard to the influence of the design and operation of rolling stock on the track structure. It pointed out in connection with the latter group of subjects that very few of them can be taken up in a thorough manner unless larger facilities and funds are made available.

The report was presented by Dr. Talbot and was received without comment.

* Professor Emeritus, University of Illinois.

Wooden Bridges and Trestles

H. Austill, Chairman*

The committee presented comprehensive reports on eight of its nine assignments, bringing to conclusion a number of matters studied during recent years, and opening up a number of new subjects.

Revision of the Manual—The committee recommended revisions at more than 20 places in the Manual, involving changes all the way from minor revisions and deletions to substitutions for entire sections. Among the general changes recommended was the substitution of the words "wood" for "wooden", "framed" for "frame," and "ballasted deck" for "ballast deck," wherever appearing in the Manual. Some of the more important specific changes recommended are as follows: Add new drawing, "Recommended Practice for Cap-Stringer Fastenings Other Than Drift Bolts"; Substitute revised specifications for wood piles, page 469; revise names of certain species of lumber and timber under grading rules and classification of timber and lumber for railway use, pages 472 to 474; add nomenclature of commercial domestic hardwoods to grading rules and classification; substitute complete specifications for wood shingles for notes on pages 494 to 497, inclusive; substitute revised classification of the uses of lumber and timber under A.R.E.A. specifications, pages 552 to 557, inclusive.

With one minor change, all of the revisions recommended in the Manual were adopted without discussion, following which Dr. Hermann von Schrenk (consulting timber engineer), complimenting the committee upon the thoroughness of its work, said that, with the adoption of the revised specifications for wood piles, this is the first time that the major engineering organizations of the country have had specifications for wood piles that agree in all particulars.

Simplification of Grading Rules—Following two years' study in collaboration with others in an attempt to prepare specifications for wood for structural use in an improved and more convenient form than is given in the 1929 Manual, the committee, under the general head "Grading Structural Timbers on the Basis of Unit Working Stresses—1936," presented a foreword; specifications for structural timbers; tables of standard stress-grades and working stresses for joists and plank, beams and stringers, posts and timbers; and notes on the use of stress-grades.

In submitting this new material, the committee commented as follows:

A preliminary report on this subject was presented for information at the 1935 convention and was published in Bulletin 374. After intensive study, the committee made a change in the editorial form of the specifications without altering the general objective in that report. A major editorial change was made to cast the specification in the recommended A.R.E.A. form. At-

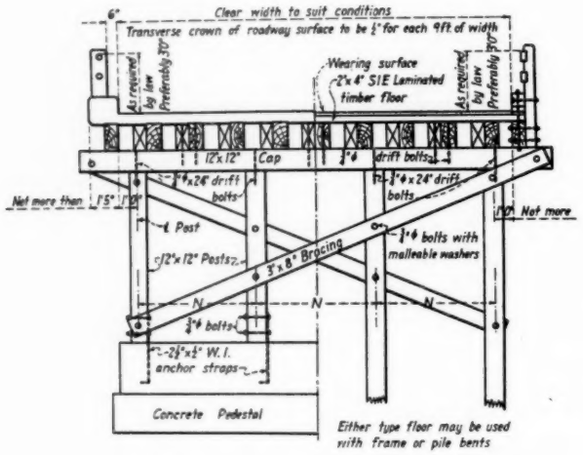
* Bridge Engineer, Mobile & Ohio.

tention was also given to shortening the report as far as possible.

The committee recommended that the foreword, specifications, tables and notes on stresses submitted, be adopted for publication in the Manual, replacing all material now in the Manual, pages 505 to 551, and 558 to 560, with which it would conflict.

This recommendation, with only minor changes suggested by the committee itself in submitting the report, was adopted.

Overhead Highway Bridges—The committee resubmitted a plan submitted last year for a timber overhead highway bridge,



Bent and Floor Arrangement Recommended for Overhead Wood Highway Bridges, H-15 Loading

showing details for both concrete and laminated wood floors. This plan, which was refined in detail during the year, was offered for approval and publication in the Manual. The committee recommended that the subject be continued so that it might develop another plan to provide for long panels with metal stringers, sidewalk details and other features. The plan stipulated was adopted without discussion.

Design of Wooden Trestle for Heavy Loadings—Continuing its work of last year, when it presented for discussion a proposed plan for open deck timber trestles for E-72 loading, and a plan of recommended practice for walks and platforms on open deck trestles, the committee resubmitted these same plans, revised to meet certain criticisms, and recommended that they be approved for inclusion in the Manual, together with the table of stresses for the trestle design. The plan for the open deck trestle calls for six-post frame bents on concrete pedestals or piles, or for six-pile bents, in both cases for heights up to 30 ft. In the nature of new work, the committee presented as information, with the hope of securing approval next year, a plan for a ballasted deck trestle for E-72 loading, together with the table of stresses for this design. In the text of its report, it discussed the various changes made during the year in the open deck trestle plan, and also certain features of the new tentative plan for ballasted deck trestles. The plans and table recommended were adopted.

Bearing Power of Wood Piles—During the year, the committee collaborated with other interested organizations and compiled a bibliography of material relating to the bearing power of piles, supplementing and bringing up to date the material on piles which appeared in the "Bibliography of Physical Properties and Bearing Value of Soils," compiled by Morris Schrero and published in the proceedings of the American Society of Civil Engineers, August, 1931. It reported, however, that its bibliography was not in final form for presentation to the association, but was in mimeograph form and would be made available to those particularly interested. The report was accepted as information.

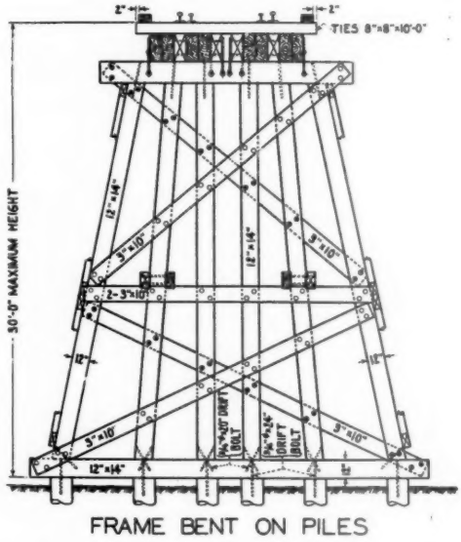
Relationship Between the Energy of Hammer and Weight or Mass of Piles—In developing a recommended relationship between hammer and pile for proper driving, the committee questioned various agencies actively connected with driving piles as to the method they use for determining the weight of hammer used in actual practice. A summary of the information received, which was supplied by the Navy department; the McKiernan Terry Corporation, the Vulcan Iron Works; the Oregon State Highway Commission; and Harrington & Cortelyou, was presented as the committee's report. In addition, however, the committee invited attention to several works on pile driving by various authors, and then presented, as Exhibit A, a treatise on the bearing power of wood piles, by W. N. Keeney, bridge engineer, American Wood Preservers Association, and a member of the committee. This treatise deals with the various theoretical formulae for bearing power of wood piles and a theoretical method of determining the best relationships between the energy of hammer and the weight or mass of pile for proper pile driving. The report was received as information.

Specifications for Bridge and Trestle Fastenings—During the last year the committee made investigation of the various designs of O. G. washers, separators, boat spikes, guard rail lag screws, drift bolts and timber construction bolts used on various railways, and in its report it summarized its findings. In addition, it discussed at some length timber metal connectors for joints in timber construction, giving particular attention to the square, circular and oval types of Bulldog connectors, and the split-ring and toothed-ring, or alligator, connectors, which types it felt would be the most useful in the bracing system of timber trestles. Following this discussion, the committee offered the following recommendations:

(1) That the present specifications in the Manual covering the design and manufacture of cast or malleable washers and/or separators be continued, and that no changes or additions thereto be made at the present time.

(2) That boat spikes, lag screws, drift bolts and construction bolts, when they are not made by the railway company, should be purchased to manufacturers' standards.

(3) That the use of modern connectors, especially the 3-in. by 4-in. oval connector, be given thorough trial in bracing sys-



One of the Types of Bents Recommended for Open Deck Railroad Trestles, E-72 Loading

tem joints with the idea of developing commercial production of a suitable type of connector.

(4) That at all points where lateral or longitudinal bracing is fastened to posts or piles, not less than two bolts, each 1 in. in diameter, be specified. This report was presented and accepted as information.

Specifications for Overhead Highway Bridges—The committee attempted to review the specifications for highway bridges of the Association of State Highway Officials, but advised that because of revision and reprinting of these specifications by the association, it had been unable to complete its assignment in this regard.

Other Subjects—In addition to the above matters, the committee gave consideration to the subject of improved design of wood structures to give longer life with lower cost of maintenance.

Report on Wood Preservation

C. F. Ford, Chairman *

The committee reported on five of its eight assignments. It carried forward the records of tie and piling tests on which it has been reporting for a number of years, and again gave considerable attention to termites and termite control.

Service Test Records for Treated Ties—As in previous years the report on this subject contained the usual table of tie renewals per mile maintained on various roads, revised to include the renewals made in 1934. It also included a series of reports on special tie tests made over a period of years on the Baltimore & Ohio; the Chicago, Burlington & Quincy; the Chicago, Milwaukee, St. Paul & Pacific; the Interstate Public Service Company of Indiana; and the Northern Pacific.

Piling Used For Marine Construction—Following its usual practice of recent years, the committee reported on the present condition of long-time test pieces and other tests prepared and observed by itself, the Chemical Warfare Service and other cooperators. For a second year, considerable attention was again given to the attack of marine borers along the North Atlantic coast and at certain points on the Pacific coast. In summarizing its report, the committee commented, in part, as follows:

The Panama Canal tests have now been carried on for 13 years with the result that Angelique, Manbarklak, Anoura, Foengo and Sponse Hoedoe from Dutch Guiana, and Malabayabas from the Philippines, have all shown great resistance to attack. None of them have received more than surface injury in a location where untreated pine or fir would be practically destroyed in a year. Several other tropical timbers show favorable indications but have not been under test so long.

Of the first series of Chemical Warfare tests only one piece treated with fuel oil and arsenicals survives after 10 years and this treatment may be said to have failed. The copper carbonate treatment has shown more resistance, but it too cannot be considered a satisfactory treatment for permanent work. The creosote reinforced with arsenicals is still good, but this resistance may be largely because of the creosote itself. The three treatments with petroleum and arsenicals of the second Chemical Warfare series all show such heavy attack after four years that they may be considered to have failed. Because of slight attack so far after 13 years, no conclusions can yet be drawn as to the relative value of the different creosotes in the Southern Pacific test.

The New England marine borer attack seems to be extending to the north and east of Boston, but to be decreasing to the south and west except in a few harbors. The extremely heavy attack in Boston continues and has been found to be still more destructive than was thought last year because of a wider distribution of teredo and the appearance of Chelura. Apparently practically all New England harbors should be considered subject to attack at times and consequently structures should be protected. There are no indications of a change in conditions in New York harbor except in Newark bay.

Destruction by Termites and Means of Prevention—The committee reported many inquiries from railway officers with regard to combatting the attacks of termites. In view of this indication of rather general interest in this subject, the committee, lacking any new important data, repeated in its report some of the more important suggestions for determining and preventing termite attack which appeared in its 1935 report. It said in part, as follows:

The first thing to do after termites have been noticed is to explore the building in the region where most of the destruction is noted. This exploration should, of course, be carried out in the basement or the cellar. If there is a ceiling in the cellar, it should be torn off. One should then investigate the walls and endeavor to ascertain where the termites are coming into the building. When this point has been discovered the walls should be reconstructed, using a top dressing of very rich cement and, of course, applying termite shields as described in an early report, on top of the foundation wall. If the termites are coming in through a wooden post, cut off the post, remove all wood which is in the ground and put in a concrete pier on which the post can rest. If termites are coming up in the upstairs wall, investigate all joints between concrete slabs. If they are found coming in between slabs, chisel a trench between the slabs and fill with a fairly soft coal tar pitch. If it is impossible to detect the exact point of entrance, a good safeguard is to expose the outside surface of the foundation wall clear to the bottom. After allowing the stone to dry, brush with a wire brush. Put on a coat of rich cement and after this is dry apply several coats of coal tar and tar-saturated felt.

While the above hints are necessarily very general, if one keeps in mind the fact that termites come from the soil into a building and that they can get in through woodwork in contact with the soil; that they enter through cracks in concrete slabs; and that coal tar compounds, both creosote and coal tar pitch, are repellants of great permanence, it will usually be possible to develop effective reconstruction methods.

The committee considers it of equal importance to emphasize again the fact that proper design of a building in the process of construction is even more important than safe-guarding an old building. This means—have the foundation built of cement mortar. The foundation should extend for a considerable distance above the ground level if possible. Irrespective of what material the foundation wall is built, cover the top of the foundation wall with a coat of rich cement mortar and, on top of this put termite shields. Have no wood, except creosoted wood, in contact with the ground. Protect cellar window openings, door frames, etc., with rich cement mortar before the frames are inserted. Protect all water and sewer pipes with termite shields where they come into a building. For the first floor construction, use either creosoted lumber or zinc treated lumber.

At the end of its report, the committee presented a review of the new book entitled, "Our Enemy the Termite," by Dr. Thomas E. Snyder, Senior Entomologist of the United States Bureau of Entomology. The book, published by the Comstock Publishing Company, Ithaca, N. Y., was highly recommended.

Effect of Locomotive Blow-Off on Preservative in Ties—In an attempt to answer the question as to whether the blowing off of locomotive boilers, which appears to bleach the tops of ties, causes any loss of the preservative treatment used in them, the committee, collaborating with the committees on Water Service, Fire Protection and Sanitation; Economics of Railway Labor; and Maintenance of Way Work Equipment, sponsored tests on the Nickel Plate and the Chesapeake & Ohio. In these tests, ties which appeared to be the most seriously affected were taken into the laboratory, where the quantity and specific gravity of the creosote in the top center, top ends, bottom center and bottom ends were analyzed.

Following an outline of the laboratory tests and a general discussion of the results found, the committee made the following statements: All of this can be summed up in the general statement that blow-off as now practiced on the Nickel Plate and the Chesapeake & Ohio does not cause any loss of creosote from creosoted ties. It is our opinion that the results of the tests made quite possibly reflect the ultimate answer to this question. The tests made were carried out by Dr. Hermann von Schrenk, consulting timber engineer, and R. C. Bardwell, superintendent of water supply on the C. & O.

Revision of the Manual—The committee recommended the removal from the Manual of 82 terms used in connection with wood preservation. It stated that some of these terms are simply repetitions, some are relatively unimportant, while others are explained adequately in the text matter of the Manual. In addition to the above, the committee recommended more or less important changes in 10 other definitions.

The recommendations of the committee were approved.

Other Subjects—The committee stated that it had made progress in the study of the following subjects: The effect of preservative treatment with creosote and petroleum, and with zinc chloride and petroleum; the incising of all forest products material; and the determination of the toxicity value of creosote and creosote mixtures.

*Supervisor Tie and Timber Department, Chicago, Rock Island & Pacific.

Economics of Bridges and Trestles

Arthur Ridgway, Chairman *

During the last year, the committee continued intensive study of its assignment, which, in full, is to study the comparative economic value of steel, treated timber and concrete in bridges,

*Chief Engineer, Denver & Rio Grande Western.

trestles and viaducts under various conditions of service, with due consideration of the relative influence of durability of materials and obsolescence of property. In spite of its study thus far, however, the committee was unable to make other than a report of progress, stating that consideration of the meager data received, together with the work done on a similar subject inherited from the Committee on Wooden Bridges and Trestles, indicates very definitely that the matter of relative economy in the use of various materials for bridges and trestles demands unusual and exhaustive treatment. It recommended that the subject be continued, which recommendation was adopted.

Report of Committee on Masonry

Meyer Hirschthal, Chairman*

Reports were presented on seven subjects dealing with concrete, concrete structures and related matters. The chief interest in the material offered was in the matter recommended for inclusion in the Manual.

Concrete—Specifications and Principles of Design—The committee submitted for inclusion in the Manual detailed plans for reinforced concrete railroad trestles with three-pile bents, designed for Cooper's E-72 loading, and for 24-in. precast reinforced concrete, octagonal piles. As information, with the idea of securing adoption in 1937, it presented specifications for composite columns and pipe columns; specifications for the design in reinforced concrete of rigid-frame bridges without skew; and also a statement with regard to the figuring of unit stresses for buildings when wind loads are included. It reported progress in the study of specifications for ribbed floor construction, reinforced brick work, and the economics of light-weight aggregates. Affirmative action was taken on the committee's recommendations.

Progress in Concrete Manufacture—Under this assignment, the committee submitted specifications for the heat curing and wet curing of Portland cement concrete, which it recommended for adoption and inclusion in the Manual. In a second part of its report, it discussed grouting, pointing out that in connection with masonry, grouting is usually undertaken to strengthen or solidify a structure or the material supporting it; to fill cavities; or to prevent or stop the flow of water. Some of the questions answered in the discussion are as follows: (1) Who will do the work? (2) What materials should be used, whether cement, cement sand mortar, or a special material? (3) If cement or mortar is used, what should be the fluidity? (4) Shall a definite procedure be followed or shall it be a cut-and-try procedure? (5) What equipment is necessary or best adapted to the work? These specifications were adopted.

Specifications for Foundations—The committee presented general specifications covering the design and construction of ordinary simple substructures for railway structures. These specifications, while not intended as complete, were recommended for adoption and inclusion in the Manual, and the motion to take this action carried.

Lining and Relining Tunnels—Co-operating with the Committee on Roadway, the committee presented partially complete specifications for lining railway tunnels with plain concrete. These specifications, which are intended to apply to the relining of old tunnels through ordinary formations which involve no special features, as well as to the lining of new tunnels, were offered for adoption and inclusion in the Manual, and were so received.

Expansion Joints in Masonry Structures—For the last several years the committee has made an intensive study of this subject, drawing recommendations and criticisms of plans from a large number of roads. Following up earlier work, it sent out a questionnaire in 1934 covering the various types of expansion joints involved in masonry structures. An insufficient number of returns were received early in 1935 to permit submitting a complete report, but with 15 replies in hand by the end of the year, the committee drew up its report, with which it submitted answers to the questionnaire in tabulated form, together with 17 plans of joint details. As a result of its study, it found it inadvisable to attempt to draw a general specification for expansion joints. In this regard, it commented as follows:

Since each expansion joint is a problem of design to meet some particular condition, and the details are an intimate part of the general specifications, the committee feels that a general specification to cover the design of expansion joints cannot be prepared. It recommends, therefore, that the report be received as information and the subject discontinued.

Specifications for Highway Bridges—Reporting on its assignment to review the specifications for overhead highway bridges of the Association of State Highway Officials, the committee stated that these specifications were revised recently and that copies of the new specifications were received too late to permit it to review them and make report this year.

Revision of the Manual—A considerable number of changes were recommended in connection with Manual material, largely to incorporate proper references to standards of the American Society for Testing Materials. The most important change was the recommendation that the specifications for reinforced concrete culvert pipe, Articles 141 to 177, inclusive, pages 601 to 613, be deleted and replaced by reference to A.S.T.M. Specification C-76-35T. Other revisions recommended have to do with the quality of reinforcing steel, and to proportioning and mixing, in the 1931 specifications for Portland cement concrete, wherein A.S.T.M. references are to be included; specifications for billet steel concrete reinforcement bars, pages 633 to 636, which are to be changed to refer to the appropriate A.S.T.M. specification; and Articles 4 and 13 of the specifications for Portland cement concrete, dealing with organic impurities in sand, and wire, respectively, which are to be replaced or amplified by A.S.T.M. specifications. All the changes offered were adopted.

Other Subjects—Progress was reported on the committee's assignments to establish contact with the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, and to prepare specifications for the placement of concrete by pumping.

Report on Live Load and Impact

O. F. Dalstrom, Chairman*

During its first year of work, the Committee on Live Load and Impact, a new special committee, gave consideration to both of its assignments. As regards live load, it recommended that Cooper's E 72 loading, a diagram of which was included in its report as Fig. 1 and Fig. 2, be used in designing structures carrying track. Where a different live load is desired, it was stipulated that the engineer shall specify the load to be used, but that

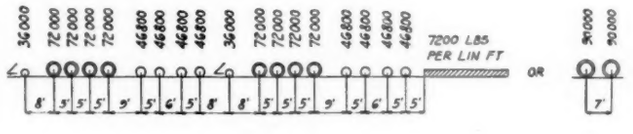


FIG 1 FIG 2

Cooper's E-72 Loading, Recommended for Use in Designing Structures Carrying Track

such load shall be proportional to the recommended load, and with the same axle spacing.

The recommendation of the committee was adopted.

Impact—The committee advised that it was not prepared to submit recommendations on impact at the present time. In a brief report on this subject, it invited attention to the record of tests and discussion in the monograph entitled "Impact in Steel Railway Bridges of Simple Span," by J. B. Hunley, a member of the committee, published in A.R.E.A. Bulletin No. 380, October, 1935. Concerning this monograph, it commented as follows:

In the Foreword to this discussion is given a brief review of the pioneer work in this field by Prof. F. E. Turneaure, dean of the College of Engineering, University of Wisconsin, the results of which were published in the A.R.E.A. proceedings of 1911. Following this review of Dean Turneaure's work is a summary of the research work carried out in foreign countries. The author then presented the report of his tests on steel bridges of the

* Concrete Engineer, Delaware, Lackawanna & Western.

* Engineer of Bridges, Chicago & North Western.

Cleveland, Cincinnati, Chicago & St. Louis Railway during 1931 to 1934, inclusive. This report is based on about 2100 test records on 39 bridges, all simple spans and most of them having open decks. This is the most comprehensive report that has been made on the subject of impact. While it served the immediate purpose that the C. C. C. & St. L. had in view and was the basis of the present A.R.E.A. impact formula for steel railway bridges, it also indicates the need of extending this research to cover spans of lengths and types different from those tested, particularly short spans, steel spans with decks carrying ballasted tracks, continuous or rigid frame structures, and concrete bridges of all types.

The report was received without discussion.

Report of Committee on Track

C. J. Geyer, Chairman *

The committee recommended numerous changes in existing material in the Manual, including all of the plans and specifications for track tools, and offered six plans for tie plates and a plan containing turnout data for curved switches for inclusion in the Manual. In addition, it reported at length on the continuous welding of rail.

Revisions of the Manual—In preparation for the new edition of the Manual, the committee gave preferred attention during the year to all of the existing material in the 1929 edition of the Manual and the Supplements thereto, and recommended numerous changes, deletions and substitutions. Following are the major deletions recommended: Material relating to the speeds of trains through curves and turnouts; index to trackwork plans; specifications for frog filler sections; specifications for relayer rail for various uses; specifications for malleable iron tie plates; specifications for steel screw track spikes; material relating to the resawing and reconditioning of rails for relaying and the building up of battered rail ends in track; and the material relating to anti-creepers. For the material deleted with regard to anti-creepers and the building up of rail ends in track, the committee recommended the substitution of the two following statements: "The use of anti-creepers to prevent longitudinal movement of the rail in track is recommended" and "The reconditioning of rail ends, frogs, switches, crossings and joint bars is recommended as good practice."

Acting on a suggestion made by J. B. Jenkins (B. & O.) the committee withdrew its recommendations concerning the deletion from the Manual of certain text and graphs relating to the speeds of trains through curves and turnouts until such time as substitute material is made available. In other respects the deletions recommended by the committee were adopted without comment.

In addition to the above recommended deletions, the committee recommended changes of a more or less important character in the material in the Manual with regard to the maintenance of line; spirals; maintenance of surface; maintenance of gage; oiling of track fixtures; and plans and specifications for track tools and track tool handles. As regards the track tool plans and specifications, the committee recommended that the material on pages 21, and 27 to 39, inclusive, Supplement to the Manual, Bulletin 367-368, covering index sheet Plan A and plans for track tools and track tool handles, be withdrawn. It also recommended that the plans covering specifications for track tools and track tool handles on pages 22 to 27, inclusive, Supplement to the Manual, same bulletin, be withdrawn. For these plans and specifications, the committee submitted a complete set of revised plans prepared in collaboration with tool manufacturers and the committees on Roadway, Ballast, and Economics of Railway Labor, which it recommended for adoption.

Referring to the material in the report relating to the maintenance of line, Mr. Jenkins pointed out that the committee's recommendations concerning the length of easement curves was at variance with material now contained in the Manual. Referring to the committee's formula for determining the elevations of curves, which is based on an unbalanced elevation of 3 in., Mr. Jenkins contended that this unbalanced elevation should be somewhat larger. These suggestions, together with others made by Mr. Jenkins relating to the correction or clarification of material now in the Manual, were taken under consideration by the committee. All other recommendations made by the committee were adopted.

In addition to the above items, the committee recommended the deletion of a number of existing definitions, and that all the remaining definitions be combined into two groups, one for the Manual, and the other for the trackwork portfolio. In this latter regard, it is its intention that all definitions included in the Manual itself be segregated into a chapter on definitions in alphabetical order at the back of the book, and that those definitions referring particularly to the trackwork portfolio plans be printed in the portfolio only. These recommendations were adopted.

Continuous Welding of Rail—In its first report on this subject, the committee presented a brief history of the continuous welding of rails on trolley lines and on foreign steam roads, and also covered recent developments of this character on steam railways in the United States. The information with regard to foreign experience, which covered Germany, Hungary, France, Egypt, Italy, Poland, Sweden, Switzerland and Australia, was presented in summary form, except in the case of Germany, where the experience with Thermit and flash rail joint welds in combination with GEO and a somewhat less sturdy track construction, was discussed in some detail.

The major part of the report had to do with experience with continuous welded rails in the United States, and, more particularly, with the three long installations of welded rails on the Delaware & Hudson which employ Thermit pressure welds and M & L track construction, except for a few flash welds which are under test. Aside from discussing the D. & H. installations, the committee presented in tabular form details with regard to continuous welded rail installations on the Boston & Maine, the Central of Georgia and the Clinchfield, where Oxweld V-type butt joint welds were employed, and on the Chicago Surface Lines and the Bessemer & Lake Erie, where Thermit pressure welds were used.

As regards the details of these installations, information on which was secured through a questionnaire, the committee made the following comments:

A study of this material would seem to indicate that thus far in this country the steam roads have been able to weld rails into long stretches in tunnels, where ordinary track construction prevails, and where the temperature varies up to 75 deg. or more, without special provision for expansion. With the more rigid type of track such as the M & L type in use on the Delaware & Hudson, and the GEO type in use on the Bessemer & Lake Erie, it has been possible to weld rails in lengths up to 12,000 ft. without any excessive movement either laterally or lengthwise, with a temperature change up to 125 deg.

Following a description of the V-type butt weld produced with the oxy-acetylene flame, and of the Thermit pressure weld, the committee described the more recent development of flash welding rails together, as follows:

Flash welding is a method of butt welding by continuous arcing between the ends of the parts to be joined. The two ends of the rails are clamped in the welding machine. One of the clamps is movable, and both clamps are connected to the terminals of a low voltage transformer. No particular preparation of the rail faces is needed, although reasonably parallel surfaces expedite the operation. No flux is used. The metal is volatilized by the arc, and a pressure of gas is built up between the surfaces during the arcing, this pressure preventing access of air to the faces. Therefore, there is no oxidation of the metal, and the faces are kept chemically clean. The pressure of the gas blows all molten metal out of the gap, and at the proper time—about two minutes after starting the arcing—the faces are brought together under heavy pressure. This squeezes out all metal that is molten, and the weld is made. This process is, in fact, a hot work weld. Only a trace of cast metal remains in the joint.

With regard to the expansion and contraction of long welded rails, the committee presented the results of an exhaustive investigation made by the Delaware & Hudson, which indicates that, both in this country and abroad, the tendency of long rails in track to expand or contract is greatly decreased from the theoretical. So far as the D. & H. installations, with M & L track construction, are concerned, it was stated that the experience with long stretches of rail indicates that at the ends they have little more, if any, expansion and contraction than would

* Engineer Maintenance of Way, Chesapeake & Ohio.

be expected in the case of a 39-ft. rail in ordinary track construction.

At the end of the report, the committee discussed the costs involved in producing continuous welded rails and the possible savings in track maintenance through this type of construction. (A description of the D. & H. welded track installation appeared in the *Railway Age* of December 29, 1934.)

Track Tools—In this report the committee presented the new material covering track tools which was recommended for adoption under Revision of the Manual in substitution for material on pages 21 to 39, inclusive, in Supplement to the Manual, Bulletin 367-368. This new material, which is largely a revision and rearrangement of the material it is designed to replace, includes a table of contents, specifications for track tools, and 25 plans of the different tools and tool handles for which the association has adopted standard designs.

In this report also the committee presented two new tool plans: Plan 12-A, dated 1936 A.R.E.A., carpenter's adze, and Plan 26, scoop shovel. The plan of the adze was recommended for adoption and publication in the Manual, while the plan of the scoop shovel was submitted as information for criticism. Supplementing these tool plans, the committee submitted as information a conversion graph for readily converting from one to another, Brinell, Rockwell and scleroscope hardness numbers. The recommendations of the committee were adopted without comment.

Switches, Frogs, Crossings, Slip Switches, etc.—The committee presented for adoption Plan 920, Turnout Data for Curved Switches, which was prepared in conference with the Standardization committee of the Manganese Track Society. In submitting the plan, the committee pointed out that high operating speeds make the use of curved switches desirable in turnouts and crossovers, in that such switches provide greater safety and comfort, improve operating conditions for long rigid wheelbase locomotives, and result in economy in congested terminals where shorter leads make possible savings that could not be obtained with longer leads. The committee advised that it has under consideration the revision of a number of plans now appearing in the book of trackwork plans, but was not prepared to make a detailed report on this matter at the present time.

Acting on a suggestion made by J. V. Neubert (N.Y.C.) the committee agreed to delete the word "safety" from the sentence outlining the advantages of curved switches. The recommendation of the committee that Plan 920 be printed in the Manual was then adopted without further discussion .

Design of Tie Plate for RE Rail Sections—Continuing its study of tie plates after failure to secure adoption of designs submitted in both 1934 and 1935, the committee, collaborating with the committees on Ties and Rail, prepared six new designs of tie plates for use with the new 112-lb. and 131-lb. RE rail sections, which it submitted for adoption and inclusion in the Manual. The new designs have the following characteristics:

Plan No.	Length	Ends	For use with	Eccentricity
1.....	10½ inches	Inclined	112 lb. RE Rail	3/16 inch
2.....	11 "	"	112 " " "	3/8 "
3.....	12 "	"	131 " " "	3/8 "
4.....	12 "	Flat	112 " " "	1/4 "
5.....	13 "	"	131 " " "	1/4 "
6.....	14 "	"	131 " " "	1/2 "

All of the designs are 7¾ in. wide, a width which was selected as utilizing the available face of a normal 8-in. tie.

Plans Nos. 2, 3, 4 and 5 present two pairs of designs; two designs for use with 112-lb. RE rail and two for use with 131-lb. RE rail; in each case, one design with flat ends for use with screw "hold down" spikes, and one design with inclined ends for use with cut "hold down" spikes, or not to be separately attached to the tie, as desired.

All designs have either double or single shoulder, except Plan No. 6, which has double shoulder only. All are canted approximately 1 to 40. The designs with inclined ends provide for either rolled crown or pressed camber, or no camber, while those with flat ends have rolled crown only. The bottom design is left optional with the purchaser, except that the design in Plan No. 6 has flat bottom only. The locations of spike holes are also left optional with the purchaser. Thicknesses are the minimum which will give satisfactory service when manufactured in "medium grade" steel in accordance with current A.R.E.A. specifications.

Position of Abutting Rails of Fixed and Drawspan Bridges—Since the report on this subject at the 1935 convention, when it was recommended that this subject be discontinued, certain points of difference on the subject have arisen, which the committee stated that it proposes to attempt to adjust.

Other Subjects—Progress was reported by the committee in the study of its assignments on corrosion of rail and fastenings in tunnels; the practicability of using "Reflex" units for switch lamps and targets; and the reclamation of serviceable material from scrap and from retired maintenance of way and structures machines, tools and appliances.

Report of Committee on Ballast

A. D. Kennedy, Chairman*

The attention of the committee during the year was given over largely to the complete revision or preparation of specifications for stone, prepared gravel and prepared slag ballasts, although, in a complete review of the material in the Manual with reference to ballast, many minor revisions, deletions and substitutions were recommended in the interest of completeness and accuracy, improving specifications, and removing material that is obsolete or not properly within the province of the committee.

Revision of the Manual—The most important work done under this assignment was the preparation of revised specifications for prepared gravel ballast, to be substituted for existing specifications in Supplement to the Manual Bulletin 337, and the preparation of new specifications for stone ballast, which were submitted for criticism with the hope of recommending them for adoption in 1937, as a substitute for existing specifications adopted in 1931. The committee stated that the revised specifications for prepared gravel ballast include improved methods of test, and offer grading limits for aggregates which are within the limits of what can be reasonably expected of a well-equipped producer, and which will, at the same time, produce a better graduation of ballast.

In preparing the new specifications for stone ballast, the committee gave special consideration to gradation of sizes, methods of test, test limits, and the order of presentation. In presenting the specifications, it called attention to the omission of the requirement with regard to cementing value. In support of the omission of the cementing value requirement, the committee presented a supplemental report of an investigation of this requirement as now used by the various railways. This report showed that of 58 roads questioned, only 6 have a cementing value requirement in their specifications, and that among the six, five of which specify the A.R.E.A. method of making the cementing value test, the requirements set up vary all the way from 1 lb. to 450 lb. per sq. in., indicating that an inconsistency exists, either in the method of making the test or in the test requirements of the roads specifying the A.R.E.A. method. Special tests carried out by these roads at the instance of the committee showed the present recommended method for determining cementing value unreliable.

In connection with the new specifications for stone ballast, the committee also presented a supplemental report on the proper test limits for stone ballast. In this it was contended that rather than have one set of test limits, it would be more practicable and helpful to have graduated limits which would indicate excellent, very good, good or fairly good, and poor. It pointed out that a railroad, in writing its own specification, could then select that set of test values which best suit its local needs.

In addition to the above considerations in connection with Manual material, the committee recommended numerous other revisions, deletions and substitutions of more or less importance, some of these having to do with definitions, specifications for pit-run gravel ballast and for burnt clay ballast, and items with reference to ballasting and surfacing equipment and organizations. Much of the material deleted was designated as obsolete or outside the province of the committee.

C. W. Baldridge (A. T. & S. F.) raised objection to the references made to specifications of other organizations, on the ground that the requirements of these specifications were not explained or quoted by the committee, for which reason a person using the specifications as revised by the committee would find it necessary also to have copies of all of the speci-

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fications to which reference is made. He maintained that the Manual should be complete and self-contained and that all association specifications should, therefore, contain all of the provisions they are intended to cover.

J. C. Irwin (B. & A.) said that it would be impossible for the A.R.E.A. to duplicate the work of allied organizations or to print the mass of material which would be involved in including all such specifications in the Manual. At the request of the president, J. C. Brumley, (editor of the Manual), told of the difficulties that would be involved if all of the provisions of specifications of other organizations to which reference was made, were to be included in the Manual, these including higher cost, unwieldy bulk, and difficulty of arrangement. The recommendations of the committee were then approved.

Prepared Slag Ballast—Under this assignment, the committee prepared specifications for prepared blast furnace slag ballast, which it submitted without comment other than a recommendation that the specifications be approved for inclusion in the Manual. These specifications were approved.

Economics of Railway Labor

F. S. Schwinn, Chairman*

The committee presented reports on seven of its nine assignments, giving major attention to weed killing, gang organization, and out-of-face renewal of track. No additions to or revisions in the Manual were recommended.

Economics of Methods of Weed Killing—The committee presented a thorough discussion of the problem of weed growth in the tracks of the railways, various means of weed eradication, and comparative costs of doing this work. The report, illustrated to show the effectiveness of weed control by various methods, began with a general discussion of the subject, which was followed by answers to the questions of why, when and how to kill weeds. With regard to the question of why weeds should be killed, the committee said that the presence of vegetation in the roadbed hastens fouling and clogging of the ballast and prevents proper drainage, one of the essentials of good track. Therefore, it pointed out that keeping a roadbed free from weeds not only reduces maintenance costs, but capital expenditures for new ballast as well. In covering this phase of its discussion, the committee quoted at some length from an article in the June, 1933, issue of *Railway Engineering and Maintenance*, which discussed the practices of weed killing on 34 roads.

In answering the question of what weeds to kill, the committee presented a list of the 50 worst weeds in the United States, together with brief descriptions of their flowers for identification, and the regions in which they are most troublesome, prepared by the United States Department of Agriculture. In the discussion of how to kill weeds, the committee described briefly hand weeding, steam weed destroyers, weed burners, mowing machines, ballast discers, chemicals and oil, and in a discussion of costs, it presented figures on the various methods, obtained from a large number of roads. In this latter regard, the committee pointed out that differences in cost of weed control by different means do not necessarily reflect superiority of any particular method. On this point, it stated that each method has its field, and that although the cost of one method may be greater than another, the benefits from using such a method may be proportionately greater.

Gang Organization—The committee, confining its attention to organizations for rail end welding and hardening, first discussed the necessity for the proper programming of any welding program, and then suggested that this programming for a given territory should be done by the division engineer or similar chief maintenance officer on the territory, who can visualize conditions on the territory as a whole. It then discussed the principles to be followed in the organization of forces and, in this connection, presented outlines for four gang organizations employing the oxy-acetylene gas method of welding. In commenting on these organizations, the committee said as follows:

Each of these organizations is predicated on the use of six welders, as this is the maximum number whose production under steady performance can be surface-ground by one grinding machine when this method of finishing is employed. These may be termed unit-gangs, of which the number required is determined by the volume of work, particularly with any necessary adjustments due to conditions peculiar to the job. They are intended for use under ordinary conditions on out-of-face work, where joints are to be cross-slotted, and it is assumed that the track will be put in satisfactory condition prior to the welding—that is, that section or other forces shall put all joints in good surface immediately in advance of the welding, and also apply new or reconditioned joint bars or shims, and tighten or renew fittings as may be required.

As a result of its study, the committee offered the following conclusions:

(1) A welding program for a given division or local territory should be based on knowledge secured from a personal inspection of rail by the chief maintenance officer of that territory.

(2) Welding work should be co-ordinated with other maintenance operations, particularly with respect to new rail and surfacing.

(3) Efficient utilization of modern equipment and the introduction of new methods can be brought about most economically by a gang organization designed specifically for such equipment.

(4) The work should be adequately supervised, and periodic checks should be made to determine: (a) If proper organization of forces is being followed; (b) if welding is being performed according to specifications; and (c) when heat-treating, if desired rail hardness is being secured without injury to the rail.

Out-of-Face Renewal of Track—Finding little experience on American roads in the renewing of track out-of-face, the committee, in its report, gave primary attention to the practices in this regard in Germany and England. In this regard, it quoted at length from an address before the Roadmasters' Association, by J. V. Neubert, chief engineer maintenance, New York Central, and published in *Railway Engineering and Maintenance* for October, 1930, and then presented in concise form details concerning maintenance and renewal practices in Germany and England, submitted respectively by Dr. Theodor Buchholz, consulting engineer, Berlin, and C. E. R. Sherrington, secretary of railways research service, London.

The committee offered the following conclusions:

According to the investigations made by the committee, the principal difference between American and European practice lies in the matter of out-of-face renewals of ties and out-of-face surfacing. For many years American railways have replaced rail and fastenings out-of-face as is done in European countries. It is the opinion of the committee that the out-of-face renewal of ties in European countries has been made economical and practical largely as a result of the longer tie life and control of mechanical wear secured by the use of relatively large tie plates, independently and securely fastened to the ties. It is further the opinion of the committee that the practice of out-of-face surfacing is made practical and economical in these countries as a result of the well drained and compacted roadbeds, and because of the high relative strength of the track structure compared with the wheel loadings. The committee wishes to draw attention in this connection to the increasing practice in recent years on many American railways of performing out-of-face surfacing every three to four years on heavy traffic sections, making all tie renewals at these times that will be required prior to the next surfacing period.

Effects of Recent Developments in Maintenance of Way Practices on Gang Organization—After reference to its three earlier reports on this subject, ending with that in 1933, the committee called attention to the many factors which in recent years have had an influence on maintenance of way work organizations and then emphasized the importance of special study of this subject at this time. In the body of its report, the committee presented a brief review of the experiences of the pioneer roads with their reorganizations of forces, as described in its earlier reports, and to this it added information obtained from certain other railways which have made extensive reorganizations since its last report. The new roads covered include the Chicago, Rock Island & Pacific; the Southern Pacific; the Wichita Valley; and the New York, New Haven & Hartford.

The following conclusion was presented at the end of the report: Improvements made in the track structure during the years from 1922 to 1930 have reduced routine maintenance work and permit the delegation of heavy maintenance in a systematic manner to specialized gangs fully equipped with labor-saving devices, with resulting economies.

* Assistant Chief Engineer, Missouri Pacific Lines.

G. M. Cornell (C. & O.) inquired whether the committee had investigated the quality of the work performed by the reorganized forces as well as the efficiency of the newer practices with respect to volume of work performed and its cost. In reply, G. M. Magee (K. C. S.), chairman of the subcommittee, said that the report reflected the opinions of the maintenance officers of the roads from which the information was obtained, but that the committee had not made specific investigation of the question raised by Mr. Cornell. Commenting on the inquiry, the president said that this is a question which must be studied intensively in the immediate future.

Maintaining Track on Various Kinds and Depth of Ballast—The committee, studying this assignment for the first year, was unable to find any road that kept its records and cost data in such shape that a proper answer to the assignment could be developed. Furthermore, it found the interjection of the factor of depth of ballast into the assignment made the problem unnecessarily difficult. It recognized the fact that inadequate depth of ballast would have an important effect upon the cost of track maintenance, but expressed its belief that few main tracks in the country today are now carried on ballast of insufficient depth. In view of these considerations, the committee recommended that its assignment be changed to read "Comparative costs of maintaining track on various kinds of ballast," and be reassigned for further study.

Operations of Roads That Have Greatly Reduced Labor Requirements—The committee advised that last November it made an inspection trip over the Norfolk & Western, at which time it obtained valuable information for a subsequent report.

Economies in Labor Through Rail-End Welding and Use of Reformed Bars—The committee contacted a number of railways with the intent of developing the extent to which track labor is affected as the result of rail-end welding and the use of reformed bars, and found that very few roads have cost data reflecting the desired comparisons. It stated, however, that from information at hand, it is apparent that appreciable labor economies may be anticipated.

Other Subjects—Progress was reported by the committee in the study of revisions of the Manual and the economies in labor to be effected through increased capital expenditures.

Report on Waterways and Harbors

A. P. Wenzell, Chairman *

The report of this committee was presented by Vice-Chairman G. P. Palmer, engineer maintenance and construction, Baltimore & Ohio Chicago Terminal Railway, Chicago.

The two most important features of the committee's report were its discussion of the lack of sound economic principles behind many of the federal waterway improvement projects, and its treatise on levees in a final report on this subject.

Economic Principles Involved in Clearances Over Navigable Streams—As the result of further development of studies which it has made of certain federal waterway projects in the Central West, the committee, supplementing its report of last year on this subject, described the procedure in handling proposals for federal waterway projects, from inception to final authorization; pointed out the lack of economic reasoning in various stages of this procedure; and not only cautioned representatives of the railways of their duty to present the case of the railways where their properties are put in jeopardy through physical damage or loss of traffic, but also advised them definitely when and how to defend the interest of the railways to the best advantage.

After describing how a proposal is passed on down through the War department to the district engineer in the field for investigation, and then the character of the investigation made by the district engineer, including a public hearing, the committee made the following statement:

In general, the public hearings before the district engineer present the best opportunity to secure modifications in plans or the inclusion of data not disclosed by the district engineer's investigation. When the report is concluded by the district engineer, it becomes a semi-confidential document and is not available for detailed inspection. The importance of the railway companies presenting data to the district engineer cannot be overstressed, as this presents the best opportunity of getting the company's data into the records that are finally lodged with Congress.

Questioning the scope and thoroughness of the economic study of federal waterway projects, and pointing out the obligation of the representatives of the railways to see that the economic study is made fully complete and accurate, the committee said, in part, as follows:

Army engineers are unlike those engaged by industry. The army engineer takes into consideration only those items of cost which are directly concerned with the creation of the project and which are to be borne by the government from funds secured through taxation. He usually does not include the items of cost which may be imposed upon individuals, municipalities, or railway companies for collateral costs incurred in building longer and higher bridges; in the relocation of facilities serving industries; and probably the relocation and reconstruction of the railway companies' yards and other facilities. The district engineer's cost of operation does not include interest on the increased capitalization due to collateral costs, or increased operating expense due to changed conditions. His estimates do not include amortization, obsolescence, and interest on capital invested in the project. The engineer in industry must prove his case and show that the gross income is large enough to meet the recurring annual expense of operation, maintenance, amortization, taxes, insurance, and interest on invested capital, and have enough left over to attract the investment of private capital.

It is to be observed that army engineers include in their estimates of savings those which accrue directly to the business using the improvement and do not undertake to develop the loss in business that may be sustained by the competitors to the waterways. The capital for the waterway improvement is provided by levies on all business of corporations, and individuals as well, and the interest on the money so invested is not passed on to the waterway users. The money spent on waterway projects where navigation is involved ordinarily means loss of traffic to competing forms of transportation. The railways, as substantial taxpayers, should present complete data, where possible, of such loss.

Waterways or other classes of industrial projects financed by government money, secured by taxation, should be put on the same basis as like improvements financed by private capital. The initial cost should include the construction cost entailed in carrying out the project, and the cost to be incurred by municipalities, corporations and individuals to meet the changed conditions imposed by the construction of the federal improvement project. The government should also assume the extra cost of maintenance and operation created by the changed conditions.

Representatives of the railways should include in their brief to be presented at all public hearings on waterways, the elements of initial cost, development cost, and annual cost, developed in the "Definitions of Terms Pertaining to Public Improvement Projects," contained in this committee's report which was presented to the association in March, 1935.

Discussing the clearances for structures over navigable waters, the committee pointed out that in connection with the development of federal projects, land transportation interests, including the railways, are often required to meet demands for greater horizontal and vertical clearances than are needed. With this in mind, it recommended that the following resolution be adopted and published in the Manual:

"Proper clearances for structures over navigable waters are those that will not interfere with the operation of either land or water transportation, cause unwise expenditures to be made for physical readjustments, or place burdensome restrictions on their future expansion. There must be an economic balance in the interest of both forms of transportation."

This resolution was adopted.

Cost for Construction, Maintenance and Operation of Bridges Over Navigable Waterways—Last year the committee presented as information a form to be used by the railways in compiling data on the cost of construction, maintenance and operation of bridges over navigable waterways. As the result of further study, the committee changed this form to a questionnaire, entitled "Railroad structures over navigable streams or waterways in the United States," which it submitted for adoption, but not for inclusion in the Manual. The committee expressed the belief that the questionnaire will develop in each case the infor-

*Until his death on September 22, 1935, Special Engineer, New York Central.

mation needed to ascertain the costs which are borne by the railways on account of the navigation requirements on streams and waterways.

Levees, Dikes and Mattresses—Following a series of reports on this subject in recent years, the committee this year presented a final report on levees, which it recommended to be received as information. Beginning with an historical treatise on levees, from ancient times to the most recent levees along the Mississippi river, the report discussed in detail the types of levees in use, location, design, materials, foundations, construction, maintenance, failures, interior drainage and expenditures upon levees under the jurisdiction of the Mississippi River Commission from 1882 to date. This was followed by a series of references to published works on levees and by an index of previous reports made on this subject by the committee.

In closing its report, the committee offered the following conclusion:

Conditions governing the selection of a suitable type of levee construction vary so widely at various locations that no brief general rules can be laid down other than the necessity for weighing such of the various controlling factors mentioned in this report as may bear upon the individual case. In connection with any proposed project, a review of experience upon similar projects will be beneficial.

Revision of the Manual—Under this assignment, the committee recommended that the specifications for the construction of the several types of river bank protection in common use, as included in Supplement to the Manual, Bulletin 279, beginning on page 92, be deleted. It also recommended the deletion from the same Supplement, beginning on page 87, of 72 of the definitions pertaining to waterways and harbors. In recommending these deletions, the committee reported that it has in mind retaining only definitions of words or terms, the meaning of which is not clearly established, or which have a peculiar meaning when applied to the subject-matter of reports submitted on waterways and harbors.

These recommendations were approved.

Other Subjects—Progress was reported in the study of the following subjects: Types of breakwaters, bulkheads, jetties and seawalls; types of warehouse piers, coal piers, car float piers and others on the Great Lakes and seacoast suitable for use under varying conditions; and size and depth of slips required for various traffic conditions, including cost of construction and maintenance.

Report of Committee on Clearances

A. R. Wilson, Chairman*

During the last year it appeared desirable to the committee to review critically the various clearance and limiting equipment diagrams established and promulgated by itself and the old American Railway Association, and to assemble this data, revised as necessary, in one place where it would be readily accessible to those railway officers who have need for it.

Such a study was made and, as a result, the committee presented with its report a group of 12 clearance diagrams and two limiting equipment diagrams, together with a group of five qualifying notations, which it recommended for adoption. The various clearance diagrams apply to bridges; turntables; single track tunnels; double track tunnels; permanent structures adjacent to main tracks; buildings and sheds; warehouse and engine house doors, low platforms; high platforms; two-lane highway traffic; electric railway and two-lane highway traffic; and single track electric railway and one-lane highway traffic. Of the equipment diagrams, one is unrestricted and the other unrestricted for main lines.

Diagram 5, applying to the permanent structures adjacent to main tracks, was referred back to the committee for further study. Diagrams 10, 11 and 12, applying to highway clearances for undercrossings, were rejected and the remaining diagrams were adopted.

In addition to recommending approval of these diagrams by the A.R.E.A., the committee recommended that the diagrams, with the supplemental notations, be submitted to the Association of American Railroads with the recommendation that they, together with similar data developed by other sections of the Engineering division and by the Telegraph and Telephone section, be published in a special pamphlet and promulgated as the recommended practice of the A.A.R. for clearances.

This recommendation was approved.

* Engineer of Bridges and Buildings, Pennsylvania.

Report on Records and Accounts

C. C. Haire, Chairman*

In reports on eight assignments, the committee covered a wide range of subjects having to do with the proper preparation and maintenance of records and accounts. Several important additions to the Manual were recommended.

Revision of the Manual—In order to embrace more fully the scope of the subject matter in its section of the Manual, the committee divided the material into four major subdivisions, namely: (A)—General—Records and Reports; (B)—Construction Records; (C)—Maintenance of Way and Structures Records and Reports; and (D)—Property Records and Reports. Five major additions to the Manual were recommended as follows:

The graphic symbols in Vol. 36, under "Office and Drafting Room Practices"; the specifications for the preparation of maps and profiles, in the same volume; the material under "Joint Facility Records (Condensed), in Vols. 34, 35 and 36; a new track chart, (submitted as Exhibit 2) in substitution for the chart opposite page 740 of the Manual; and the material under "System of Reports and Records Required to Budget and Control Maintenance of Way Expenditures" (condensed) appearing in Vol. 36. The condensed material with regard to joint facility records, and concerning reports and records for budgeting and controlling maintenance of way expenditures, was submitted with the committee's report as Exhibits 1 and 3, respectively.

The committee recommended further that the two definitions for "payroll", on page 81, Bulletin 337, and the word "appraised" in the definition for "salvage", on the same page, be deleted.

The recommendations of the committee were adopted.

Office and Drafting Room Practices—The committee submitted 15 plates for suggestion and criticism. These plates included revisions to the plates presented with last year's report, in addition to several new plates. The different plates submitted cover the following: Sizes of sheets for engineering drawings, forms and charts; typical titles; lettering; standard office practice; lines and line work; abbreviations; arrangement of views; and sectional views.

Maintenance of Way Accounts and Requirements—In 1925 the committee presented as a guide a chart showing an accounting and statistical report procedure for the maintenance of way department, set up on a divisional basis. Finding the tendency at the present time toward centralized accounting, or some form of it, the committee resubmitted its earlier chart (Exhibit 1) set up to conform to either a divisional or centralized accounting system.

In addition, the committee submitted the three following forms (Exhibits 2, 3 and 4) with brief explanatory comments: Exhibit 2—Divisional analysis of charges to operating expenses—maintenance of way and structures; Exhibit 3—System analysis of charges to operating expenses—maintenance of way and structures; and Exhibit 4—Man-hour report.

Construction Reports and Records—The committee, in its first study of this assignment, gave consideration to records for sidetracks, bridges and buildings. As regards a sidetrack record, it submitted, as Exhibit A, a track diagram which it thought should form a part of any record. On the same sheet with this diagram is a table for recording information which the committee thought essential, including the number of the track, its total length, the length owned by the railroad, the contract reference, and information as to who has charge of maintenance and at whose expense it is performed.

As regards bridge construction reports, the committee suggested placing in tabular form, directly on the "as built" masonry plans, all of the information called for under "Masonry" on page 734 of the 1929 Manual.

Under its consideration of building construction reports, the committee discussed the importance of and various possible methods of lettering buildings for identification. It then stated

* Auditor Capital Expenditures, Illinois Central.

that, in addition to identification, the record of buildings should contain the information necessary for maintenance and tax and insurance purposes, such as use, size, year built, kind of construction, taxing district, fire protection, etc. If offered the following conclusion: We do not deem it advisable to recommend a uniform system of numbering sidetracks and buildings, but do wish to stress the importance of some system as a means of lessening the difficulty of identification.

Methods and Forms for Keeping Property Records Up to Date—In a brief report, the committee advised of a co-operative arrangement it had worked out and put in effect with the valuation staff of the Finance, Accounting, Taxation and Valuation department of the Association of American Railroads, under which, with the valuation staff, it will (1) collect information of benefit to carriers relative to valuation matters and especially such matters as pertain to the Interstate Commerce Commission's valuation orders and methods, and (2) develop, where practicable, simplified practices for recommended use by the carriers. It then explained other details of the plan whereby the roads will be given the information collected, or developed, currently by the A.A.R., and, in summary form, annually, by itself in its report to the A.R.E.A.

As of interest to the association, the committee called attention to the decision of the Supreme Court, June 3, 1935, Chesapeake & Potomac Telephone Company versus the Maryland Public Service Corporation, on the constitutionality of a value placed on the property of the C. & P. Telephone Co., and also to the fact that the I. C. C. has, in the case of a few railways, brought their valuations up to date, as of December 31, 1934, and may do the same later for all carriers.

Changes or Revisions in the I. C. C. Classification of Accounts—The committee called attention to and explained the order of the I. C. C., dated September 16, 1935, altering the classification accounting for ballast. It stated that the principal changes resulting from the order are as follows: (a) The establishment and definition of ballast sections and the requirement that a continuing record be maintained of ballast in place; (b) hte distribution to investment account of the expense of placing additional ballast; (c) the classification of ballast in three major groups; and (d) the handling of ballast of a superior grade placed in lieu of ballast of an inferior grade as property retired and replaced.

A copy of the order was included in the report.

Bibliography—Following a practice of previous years, the committee presented a bibliographical review of books, articles, reports, court decisions, and legislation and regulatory orders appearing from November 1934 to October 1935, dealing with subjects in which it is interested.

Other Subjects—Without making report, the committee indicated progress in its study of the following subjects: Accounting and depreciation; and methods for avoiding duplication of effort and for simplifying and co-ordinating the work under the requirements of the I.C.C.

Report on Rules and Organization

E. H. Barnhart, Chairman*

In a relatively short report, the committee covered only two of its assignments—revision of the Manual, and rules for fire protection. However, it reported progress in its continuation of study of rules for the guidance of employees in the maintenance of way department as affecting the maintenance of terminal structures other than buildings, and the protection of treated ties and timber.

Revision of the Manual—Following a careful review of the manual of rules for the guidance of employees in the maintenance of way and structures department, pages 792 to 871, inclusive, the committee recommended the deletion or revision of a number of widely separated specific rules. In some cases, entirely new rules were substituted. It also recommended elimination of the table of contents immediately preceding the rules, pages 792 to 795, inclusive, and the general notes on page 795. For the latter, it recommended the substitution of the words, "See Standard Code, A.A.R.". The various rules or groups of rules affected in one way or another are as follows: General rules, 1 through 32; operating rules, 100 through 122; use of signals, 150 through 158; rules for operation of motor, hand velocipede and push cars, 263, 264, 270 and 276; supervisors of water service, 420; pumppers, 455; motor car maintainers, 470; supervisors of signals, 530 through 540; signal foremen, 550 through 556; signal maintainers, 560 through 594; duties of telegraph and telephone officers, 600 through 643; maintenance of telegraph and telephone lines and appurtenances, 1500, 1510 through 1536; 1550 through 1560, 1570 through 1581; ties, 706 and 707; ballast, 785; ballasting, 797; road crossings, 880; signals and interlocking, 900 through 905, 910 through 915, and 920 through 922; handling explosives, 2025, 2026, 2028, 2029, 2031, 2033, 2034, 2050, 2051, 2053 and 2054.

In addition to the above, the committee presented for inclusion in the Manual under the heading "Science of Organization", page 868, a new chart showing a recommended set-up of division employees in the maintenance of way department.

All of these recommendations were approved.

Rules for Fire Protection—As the result of further study and collaboration during the year with the Committee on Water Service, Fire Protection and Sanitation, the committee presented as a progress report, without comment, specific rules covering the duties of the following maintenance of way employees in preventing fires: Section foremen, watchmen, bridge and building foremen, painter foremen; and water service repairmen or gang foremen. In addition to these specific rules pertaining to these employees individually, it also presented a set of 27 rules on conduct of work, which apply to them as a group.

*Assistant Division Engineer, Baltimore & Ohio.

Report on Yards and Terminals

M. J. J. Harrison, Chairman*

The feature of the work of the committee during the year was the complete review and rearrangement of all of its material in the present Manual, although, in addition, it prepared and submitted reports on coal transfer terminals and on railway scales, and continued its study of two other subjects.

Revision of the Manual—The committee critically reviewed all of its material in the 1929 Manual and, concluding that a general rearrangement of this material would add materially to its value, effected such a rearrangement. This material as recast was submitted with the recommendation that it be accepted as a substitute for that in the present edition.

The outstanding change in the revision is the breaking up of the former section entitled "Points to Be Considered in Developing Joint Passenger Terminal Projects," and the distribution of the material therein under other headings, although certain new material was added and some of the old material was deleted.

Scales Used in Railway Service—The committee revised, condensed and brought up to date the various existing codes of specifications for four-section railway track scales and submitted a general specification covering all such scales, which it recommended be approved for publication in the Manual in substitution for the present material. The committee pointed out that in addition to replacing present Manual material, the new specifications are designed to replace the specifications for track scales for weighing grain, adopted by the A. R. A. in 1920, and the specifications for the manufacture and installation of light industrial service railway track scales, endorsed by the A. R. E. A., subject to restrictions, in 1930.

The committee also offered for adoption and inclusion in the Manual, in substitution for material on the same subject, revised specifications for the manufacture and installation of motor truck, built-in, self-contained and portable scales for railway service. It pointed out that following the adoption of the earlier specifications of this character in March, 1935, certain developments occurred which made it desirable to revise the specifications. The principal change made was to broaden the schedule of sizes and capacities of motor truck scales to include certain sizes and capacities now demanded, while, at the same time, certain other sizes of such scales, no longer of commercial importance, were deleted.

Coal Transfer Terminals—Following introductory comments with regard to the large quantity of coal transferred from rail to water and vice versa yearly, and an outline of some of the fundamental principles involved in this operation, the committee

* General Scale Inspector, Pennsylvania.

presented brief descriptions of some of the larger and more elaborately equipped coal transfer terminals of the country, supplementing its word picture with a number of general plans and elevations of typical installations of the various types. The different types of transfer described included mine to rail, river to rail and vice versa, rail to lake and vice versa, and rail to tidewater and vice versa.

Other Subjects—Progress was reported in the study of hump yards, collaborating with the Committee on Economics of Railway Operation, and, likewise, in the study of the subject of expediting freight car movements through yards, in collaboration with the same committee.

The various recommendations of the committee were accepted without comment.

Report of Committee on Highways

J. G. Brennan, Chairman*

During the year the committee advanced the study of all seven of its assignments, but made detailed report on only the four dealing with revision of the Manual; types of grade crossing protection; costs of various types of highway construction; and automatic pumping stations for underpasses.

Revision of the Manual—The revisions recommended by the committee all had to do with the subject "Highway Crossing Signs and Signals." Under this heading, the five items as they appear in the Supplement to the Manual, Bulletin 378, page 47, were revised and enlarged to include 23 items, to give consideration to flashing light and wigwag-type signals and to changes in drawings. With the text change, the committee submitted the following eight Signal Section drawing of signs and sign details: Ninety-degree cast iron crossing sign; 90 deg. reflector crossing sign assemblies; 90-deg. reflector crossing sign details; cast iron track sign; reflector track sign; details of numerals for track signs; reflector "stop when swinging" sign; and reflector "stop on red signal" sign.

All of the recommendations of the committee were approved.

Cost of Highways as Influenced by Trucks—In the opinion of the committee any effort to arrive at reliable conclusions on this assignment would require the undivided efforts of a staff of qualified engineers who are afforded ample time to co-ordinate and weigh all the available data on the subject. As a consequence, the committee confined its report to a few general observations and recommended that the subject be dropped. As regards the relationship between truck weight and strength of pavement, the committee commented in its report as follows:

In so far as weights of vehicles in their relation to the strength of pavements are concerned, there is ample evidence that heavy loads destroy pavements more rapidly than do light ones, but to express this fact in quantitative terms is fraught with marked difficulties. Much has been written on this subject by men possessed of broad experience in highway design and construction and who have been able to give their undivided time to a study of the subject. This may be explained in large part by the complexity of the problem, which is comparable with that of determining definitely how much stronger track must be for an E-75 locomotive than for an E-50 engine—a study that railway engineers have not completed.

Automatic Pumping Stations for Crossing Underpasses—The committee presented a general treatise of this subject under the heads of purpose; determining factors of design; rainfall; drainage area; runoff; inlet time; method for determining capacity of pumps and sumps; type of pumping stations; sump; pumps and electrical equipment; maintenance and operation. The various types of pumping stations were described as follows:

The tank type of station is of the dry pit type. The pumps, motors and electrical equipment are housed in a steel tank. The unit is assembled and tested in the factory and is placed entirely underground. Access for inspection and maintenance is provided by means of a manhole located on the top of the tank. The tank is dry and water reaches the pumps by gravity from the sump. Water is pumped to a manhole located nearby and is carried away by a gravity sewer.

In the dry pit and pumphouse type of station, which is the type in general use, the pumps, motors and electrical equipment are housed in a waterproof concrete pit with a pumphouse entrance at the street level. Either horizontal or vertical type pumps may be used. If horizontal pumps are used, the pumps and motors are located on the floor of the pit. With a vertical installation, the pumps are located on the floor of the pit and are connected by shafts to the motors, which are usually located above high water level. Water reaches the pumps from the sump by gravity through pipes.

The wet pit and pumphouse type of station consists of a pit with pumphouse entrance at the street level. The pumps are submerged by the water entering the pit from the sump. The motors are located above high water level and are connected to the pumps by shafts inside an outer casing. The pump pit should be divided by a wall and sluice gates provided between the pits and the sump so that the pit may be unwatered and one pump inspected or repaired while the other pump is in operation. Since the pump, shaft and motor are an integral unit, means for installing and removing them must be provided in the roof of the pumphouse.

Types of Grade Crossing Protection—The committee gave consideration to the merits of three types of gate or barrier protection for grade crossings, these including the Automatic Crossing Gate, manufactured by Automatic Crossing Gates, Inc.; the Automatic Safety Gate, being developed by the Automatic Safety Gate Company; and the Strauss Yielding Barrier, manufactured by the Wisconsin Bridge and Iron Company. In its report, it described each type of protection briefly and presented some of the claims of the manufacturers.

Other Subjects—Progress was reported in study of the following assignments: Economic aspects of grade crossing protection in lieu of grade separation; design and specifications for highway crossings at grade over railway tracks; and method of classifying grade crossings with respect to hazard.

The report of the committee was accepted without discussion.

Report on Water-Proofing Railway Structures

J. A. Lahmer, Chairman*

In a report on all four of its assignments, the committee recommended one important addition to the Manual and presented specifications for asphalt emulsions (clay type), and coal-tar emulsions (soap type).

Waterproofing and Dampproofing of Railway Structures—In 1935 the committee presented nine principles governing the waterproofing of railway structures and seven principles governing the dampproofing of such structures, together with seven notes on the desirable treatment to be given to various classes of structures. This material, with minor changes, was resubmitted this year with the recommendation that it be adopted and included in the Manual. Following are the principles promulgated by the committee.

Waterproofing

(1) Adequate and effective drainage should be provided to remove water from the waterproofed surface if practicable.

(2) Where the range of temperature varies from above freezing to below freezing, the disintegrating effect of frost action on water-saturated masonry must be recognized and adequately guarded against.

Where the temperature does not fall below freezing, the destructive effects of water penetration, but not permeation, by water free from corrosive elements are small. In cases of the passage of small quantities of water through parts of structures not subject to freezing temperatures, waterproofing should be provided only as required by appearance of surfaces or use of structure.

(3) Waterproofing should not be applied to the face of masonry subject to freezing and thawing, where water reaches that face through the masonry.

(4) The materials for waterproofing and the methods of application should be such as to insure that the waterproofing will be retained by bond, anchorage or other adequate means, in its original position as applied to the surface to be waterproofed.

(5) Where waterproofing is subject to possible injury from

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* Senior Assistant Engineer, Missouri Pacific.

abrasion, pressure, puncture or otherwise, it should be protected with a substantial covering.

(6) Waterproofing should be applied where economically justified, considering the use and probable life of the structure and the cost of obtaining adequate watertightness by design and construction.

(7) The type of waterproofing should be determined by the use and probable life of the structure, and the cost of renewal of the waterproofing:

(A) Waterproofing of the most durable and effective type should be used on permanent structures:

(a) In locations subject to water or other liquids under a hydrostatic head;

(b) Where repair or renewal is impracticable or prohibitive in cost;

(c) Where certainty of watertightness must be had because of heavy damage if water enters.

(B) Waterproofing specially designed for the purpose should be used where the structure must be protected against liquids containing corrosive and/or disintegrating substances.

(8) A waterproofing membrane on the surface adjacent to the water source is the most effective externally applied waterproofing, but difficulties of application and prohibitive cost may sometimes make consideration of some other method advisable.

(9 Surface applications on the inner faces of walls for the purpose of waterproofing against external pressure must derive their effectiveness from bond with the masonry or from closing the surface pores. Such applications can generally be considered effective only to prevent seepage under little or no head. Such coatings must be insoluble and unaffected by dampness.

Dampproofing

(1) Dampproofing is effective in preventing the accumulation of surface moisture from condensation only in proportion to its temperature-insulating value.

(2) Dampproofing will probably not be effective where masonry is subject to moisture saturation accompanied by cycles of freezing and thawing.

(3) Ordinary dampproofing is not effective against cracks or openings through the masonry.

(4) A frequent fault of one-coat dampproofing is failure to produce a continuous covering free from pin holes. This should be considered in deciding upon the number of coats that should be applied.

(5) The purpose and character of dampproofing are not such as to require special protection or covering. Where protection or covering is necessary, the conditions will usually warrant the use of waterproofing.

(6) A prime requisite of dampproof covering is that it shall stay in place. Bond with the surface is, therefore, essential.

(7) The selection of materials for dampproofing must include consideration of the effect of extremes of temperature, the effect of the sun's rays, and the physical and chemical effects of the liquid to which they will be subjected. These principles were adopted without discussion.

Waterproofing and Dampproofing as Applied to Structures—The committee presented a summation of the answers to a questionnaire sent out with regard to the waterproofing and dampproofing of existing railway structures. Under waterproofing, the report made reference to stations, shops, offices, miscellaneous buildings, subways, tunnels, grain bins, grain elevators, bridge decks, coaling stations, sumps and reservoirs. Under dampproofing, reference was made to stations, shops, offices, miscellaneous buildings, subways, tunnels, and grain bins and elevators.

In commenting upon the possibility of preparing rules to cover this class of work, the committee said as follows: The answers received to our questionnaire cover such a wide range of conditions and treatment that it is not practicable to prepare rules or recommendations for such work, particularly since the remedies in many cases included the application of proprietary or patented materials.

Specifications for Bituminous Emulsions—The committee presented as information, for criticism, specifications for asphalt emulsion of the clay type and coal tar emulsion of the soap type. It advised that consideration is being given to the preparation of specifications for other types of emulsions and for cut-back asphalt and cut-back coal tar.

Revision of the Manual—The only revision in Manual material recommended had to do with Section 61 of the specifications for membrane waterproofing, which section was revised to read as follows: At construction joints, the primer shall be omitted for a width of 9 in. on each side of the joint, and a strip of insulating paper 18 in. wide shall be laid thereon before the waterproofing is applied. This revision was adopted without comment.

Report of Committee on Buildings

G. A. Rodman, Chairman

Of the nine assignments of the committee, four were reported on in detail, while progress was reported on the remaining five. A feature of the report was the sizable number of additions to and revisions in the Manual recommended.

Specifications for Railway Buildings—Under this assignment, the committee submitted for adoption and inclusion in the Manual, the following specifications presented to the association in 1934 and published in Bulletin 373, January, 1935: Section 30F Genuine Wrought Iron Chimneys—Welded; and Section 10D Built-up Roofing, Type D-1—Asphalt Rag Felt and Asphalt (Smooth Surface) Over Wood or Pre-cast Units, and Type D-2—Asphalt Rag Felt and Asphalt (Smooth Surface) Over Homogeneous Roofs Cast in Place.

These specifications were adopted.

Adding to its group of specifications for railway buildings, the committee presented as information for criticism, a new specification—Section 26-C, for cement grouted macadam pavements, floors and platforms. The new specification covers description, scope, materials, gradation of aggregates, subgrade, forms, joints, placing coarse aggregate, compaction, grout, mixing grout, distribution of grout, final compaction, finishing, curing and opening to traffic.

Revision of the Manual—The major changes recommended in the Manual included the addition of an index for the specifications for buildings for railway purposes, and revisions of the specifications for cement, sand, lime and mortar in those sections of the specifications for buildings for railway purposes, having to do with sewers and drainage; brickwork; stone masonry and cut stone work; clay hollow tile; architectural terra cotta; concrete architectural stone; and brick chimneys. More or less minor changes were recommended in the material in the Manual with regard to passenger stations, stairways, ramps, scales, rest houses, and section tool houses, except for a new floor plan for passenger stations with one general waiting room, which was presented for substitution for the plan on page 264 of the Manual. It was recommended that all material with regard to oil houses on pages 274 and 275 of the Manual, be removed, since this subject has been transferred to the jurisdiction of the Committee on Yards and Terminals.

All of these recommendations were adopted.

Destructible Value of Structures Which Can Be Collected in Case of Fire—The committee studied the determination of the amount of money which can be collected from an insurance company when an insured structure is damaged or destroyed by fire. In its report, after pointing out the contract nature of insurance policies, the committee said, in part, as follows:

The amount which may be collected depends on the provisions of the insurance policy covering the structure. It is based on an accurate determination of the loss or damage to the insured, taking into consideration these provisions. It is, therefore, necessary to be familiar with the terms of the policy.

The amount which can be claimed in case of a partial loss, that is, when less than 50 per cent of the structure is damaged, is the cost, at current prices, to restore in kind waste and damaged materials. In the case of a total loss, the amount which can be claimed is the actual value of the property to the owner at the time of the loss or damage. This value is the cost to reproduce new, less depreciation, plus the cost of removing the debris, less the value of salvage.

In the remainder of its report, the committee discussed the correct method of arriving at the reproduction costs. In this regard, it made the following cautionary comment:

In figuring the reproduction cost, there should be included, in addition to the delivered and erected or installed cost, the following items which are a part of the cost: Architect's fees; engineering and supervision; interest during construction; contractor's supervision; contractor's overhead and profit; city permits; pub-

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lic liability insurance premiums; workmen's compensation; fire insurance during construction; owners risk and surety bonds; incidental damage to foundations, sidewalks and parts other than the superstructure; temporary protection; temporary roof coverings; protection of heating, protecting plumbing and other apparatus against freezing; clearing site of debris and all expense of whatever nature in connection therewith; work done by the railway company's forces; disposal of material at the dump; switching charges; and transportation of men and materials.

Stainless and Rust-Resisting Metals in Building Construction—The committee stated that in recent years there has been a trend toward the greater use of stainless and rust-resisting metals in building construction, particularly in connection with design, ornamentation and finish. It then discussed in a general way the wide range of metals generally classified as stainless and rust-resisting, giving particular attention to the serviceability and application in building construction of lead, zinc, copper, brass, bronze, aluminum, Monel-metal, stainless steel, nickel and chromium.

In concluding its report, the committee made the following statements:

The continued use of metals for design, ornamentation and finish, both on the interior and the exterior of buildings, requires careful study. Not only must the cost, weight, ease of fabrication and assembly, strength and other physical characteristics be taken into account, but careful consideration must also be given to their corrosive resisting and non-staining qualities; their action upon adjoining materials, such as stone and brick of the lighter textures; and other similar properties.

Generally, the various metals under discussion when used in interiors, do not become involved in chemical phenomena such as oxidation to any serious extent, so far as the metals themselves or adjoining perishable materials subject to staining are concerned. Care must be taken in combining various metals to build up ornament or to execute designs, that the possibility of galvanic action or electrolytic corrosion will be prevented. This applies both to interior and exterior work.

The application in building construction of metal and metal alloys which have stainless or rust-resisting qualities to a more or less degree covers a broad field. However, these materials should be selected for their general merits for the particular use required, giving consideration to cost if required.

The committee recommended that the subject be discontinued.

Other Subjects—Without making report, the committee indicated progress in the study of the following subjects: Influence of the design of buildings on fire insurance rates; different types of paint and their economical selection; types of foundations best suited for railway buildings; and design of small cold storage plants for railway use. It recommended that the subject of mill type and other heavy wood construction for railway buildings, on which it made a report last year, be discontinued.

Iron and Steel Structures

G. A. Haggander, Chairman*

The outstanding feature of the report of the committee was a new set of rules for rating existing iron and steel bridges, submitted with the recommendation that they be adopted and substituted for the rules and unit stresses for rating existing bridges, on pages 1248 to 1250, inclusive, in the 1929 Manual. The new rules cover carrying capacity, computation of stresses, loads and forces, dead load, live load, impact, precise determination of impact, track joint effect, lurching effect, hammer blow effect, centrifugal force, wind, sway of locomotives, lateral forces due to impact, longitudinal force, live load and impact on multiple track bridges, permissible stresses, and conclusions. As first prepared for submitting to the association, the rules were presented in Bulletin 382, December, 1935. Later, changes were made in the subject-matter relating to impact, precise determination of impact, hammer blow effect, lateral blow due to impact, and permissible stresses, and the revised rules, as actually submitted to the association, were published in Bulletin 384, February, 1936, as a supplemental report.

The rules, which were prepared by a special sub-committee, were so drafted that they would not only be entirely up-to-date, but also so that they would be consistent in every respect with the new specifications for steel railway bridges adopted at the 1935 convention.

This report was actively discussed, many questions being asked concerning various features of the rules, but particularly with respect to the portions relating to impact. A. C. Irwin (Portland Cement Association) presented a mathematical analysis which he submitted as proof that some of the provisions of the rules were not entirely sound. C. C. Westfall (I. C.) made a plea that the rules be received as information for the purpose of allowing ample opportunity for a thorough testing of their applicability before adoption. However, B. R. Leffler, subcommittee chairman, who presented the report, contended that the provisions of the new rules are so far superior to the rules to be superseded that they comprise a distinct step in advance, and a motion to adopt the rules was carried.

In addition to this revision of material in the Manual, the committee recommended removal from the Manual of the following statement under the heading "Copper-Bearing Steel for Structural Purposes," appearing in Supplement to the Manual, 1932, Bulletin 347, page 41: "From results of exposure and service tests on the use of copper-bearing steel, its value is recognized as a rust-resisting metal and its use is recommended in railway steel structures exposed to corrosive influences." The committee also proposed the withdrawal from the Manual of the specifications for Steel Highway Bridges with the recommendation that use be made of the specifications adopted by the American Association of State Highway Officials in 1935, pending further study by the committee. Both recommendations were adopted.

Other Subjects—The various subjects being studied by the committee, but on which no detailed report was made this year, are as follows: Application of and specifications for fusion welding and gas cutting for steel structures; impact on railway bridges; design for rivet heads for steel structures; stresses in wire ropes bent over sheaves; different grades of bronzes to be used for various purposes in connection with iron and steel structures; design of expansion joints involving iron and steel structures; design of tension members and connections in which rivets develop tension; effect of proposed increase in vehicular weights on highway bridges; and review specifications for overhead highway bridges of the Association of State Highway Officials in so far as they relate to steel construction.

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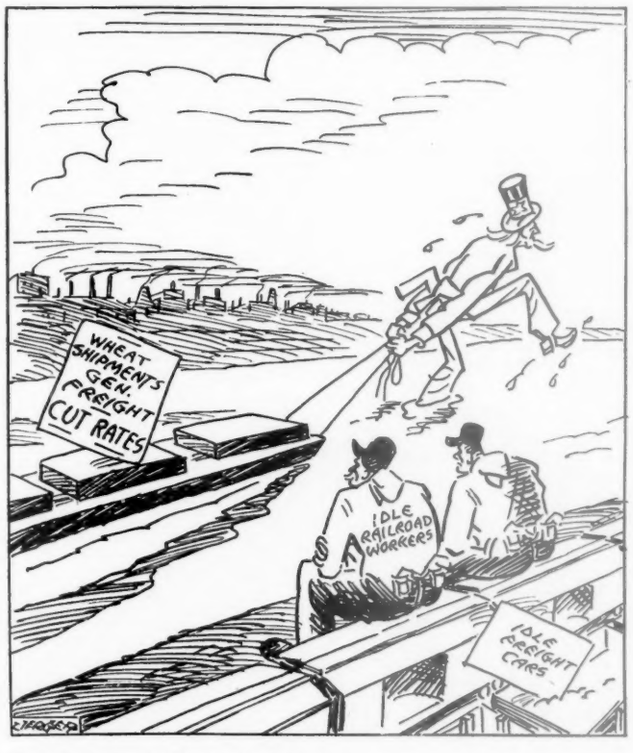


From the Locomotive Engineers Journal

One Idle Railroad Worker to the Other: "That, Buddy, Is What Is Called Solving the Transportation Problem!"

* Bridge Engineer, Chicago, Burlington & Quincy.

Signal Section Convenes in Chicago

Two-day program includes reports on cost of train stops, economies effected by signaling, new aspects for higher train speeds, and explanations of modern developments

G. H. Dryden
B. & O.
Chairman

Moffett Studio

E. G. Stradling
C. I. & L.
Chairman Elect

EXPLANATIONS of new signal aspects for higher train speeds, studies of economies and new developments in highway-railroad crossing protection were outstanding features of the forty-second annual convention of the Signal Section, A.A.R., at the Stevens Hotel in Chicago on Monday and Tuesday this week. G. H. Dryden, signal engineer of the Baltimore & Ohio, presided at the meeting, the program consisting of the reports of nine standing committees. The attendance was 418, an increase of 65 over that of last year. R. H. C. Balliet, secretary, reported the membership in the Section to be 1,752.

Chairman Dryden opened the meeting with a brief address and then introduced J. C. White, general manager, Western Region, Pennsylvania, who gave an address on "Signaling as Viewed by the Operating Officer."

In presenting the reports of the committees on Signaling Practice and on Highway Crossing Protection, the chairmen of these committees called on S. N. Mills, assistant director of the Bureau of Safety, I.C.C., who spoke at some length as to the causes of some recent train accidents. Abstracts of Chairman Dryden's address, Mr. White's comments and Mr. Mill's remarks are given below.

Address of Chairman Dryden

In assembling here to transact the business of this, the forty-second annual meeting of this organization, we are paying tribute to that small body of men who assembled in this city 41 years ago to form the Railway Signaling Club, which later was expanded to the national association now known as the Signal Section, A.A.R. Advancement of the art of signaling, improvement in the design of apparatus, and the standardization of practices—the three important objectives outlined at that meeting in 1895—have been carried on faithfully through the years by the preparation of standards of design, specifications for material, and requisites for standard practice, which have been revised from time to time in consideration of continued improvement. The accomplishments of the Signal Section during the last year have been especially progressive.

The financial condition prevailing during recent years has limited the progress in the installation of protective devices but, notwithstanding the depression, our signaling facilities are in proper operating condition. We have been able to bridge the gap without sacrificing safety, a statement which is confirmed by the fact that there was not a passenger fatality on American railroads during the year 1935.

The public has recognized its responsibility in the protection of highway-railroad crossings, and rapid strides are being made in the installation of signal protection at many crossings through the use of federal funds. I am proud to say that the many installations of flashing-light crossing signals now being made in the various states are according to requisites prepared by the Signal Section committee on Highway Crossing Protection. Under these requirements the degree of protection afforded is the equivalent of that used in the operation of trains. An important adjunct to highway crossing protection is the application of the standard reflecting signs.

Some of the important developments in the signaling field during the past year have to do with the improvement of signal aspects, the design of high capacity rectifiers, improved insulation on wirings so as to reduce the failures caused by lightning, and the development of several types of rail-head bonds.

Address of J. C. White

Proper signaling played an important part in transporting millions of persons on the railroads of the United States during the entire year of 1935 without a single passenger being killed. Signaling not only improves the safety but also effects economies in the expenses of train operation. When I was a division superintendent a few years ago, centralized traffic control was installed on 29 miles of single track of the division for the purpose of speeding up train movements by providing power-operated switch machines and signals for directing train movements by signal indication, the signals as well as the switches being controlled from a control point. As a result of this installation, the average speed of freight trains was increased 87 per cent, or from 16.3 m.p.h. to 30.6 m.p.h.; the gross ton-miles per train-hour increased 89 per cent, or from 45,709 to 86,558, and the cost per thousand gross ton-miles decreased 39 per cent, or from 35 cents to 22 cents. These improvements in freight train operation were accomplished with no changes in the line or in the locomotive tractive effort. The saving effected by the centralized traffic control in one year was $50,000.

Today, as never before in the history of railroading, there is a scarcity of young men available for advancement to supervisory positions, and this is particularly true in the transportation departments. Signal employees, in the past, have been advanced almost solely in their own field of endeavor. They have not been given the proper encouragement to gain knowledge in the broader field of transportation. This has been a handicap

to the men themselves, as well as to the railroads, and this situation can well be corrected by training young men in the signal departments for promotion as operating department officers.

Remarks by S. N. Mills

One measure of the safety of railroad operation, which results from the use of signals, is the relative freedom of lines so equipped from serious railroad accidents. The block system, including manual block and automatic block, is in service, in round figures, on 110,000 miles of the total 250,000 miles of railroad line in the United States. This block signaled mileage includes by far the greater part of the heavy-traffic lines of the country, where exposure to the risk of accident is relatively high. In addition to block signals, more than 10,000 miles of railroad line are equipped also with automatic train stop, train-control or cab-signal devices, and territory so equipped includes the whole or a considerable part of many of the routes of our present high-speed passenger trains.

During 1935, the Bureau of Safety investigated 71 railroad accidents, of which 25 were collisions; of these 25 collisions, 13 occurred on lines operated by the block system, 3 in manual-block territory, and 10 in automatic block territory. In one case automatic cab signals also were in service, and in another case automatic train-stop devices were used. Not one of these 13 accidents was due to any failure of the block-signal, cab-signal or automatic train-stop devices to function as intended. This very small number of serious accidents on lines protected by signals and train-control devices, and the reliability of operation of these devices as indicated by these investigations, presents a record for which signal engineers are in large measure responsible and may justly be proud.

In several cases outside of block-signal territory, the accident investigation reports have directed attention to need for the additional protection which would be afforded by the installation of the block system. Four of the 25 collisions investigated involved section motor cars, and these investigations indicated the need for better protection and closer supervision over the operation of railroad motor cars.

Crossing Accidents Hazardous to Trains

The hazards to railroad operation and to persons on railroad trains, which result from grade crossing accidents, merit greater emphasis and attention. During 1935 the Bureau of Safety investigated seven grade crossing accidents, some of which were very disastrous, the total casualties being 26 persons killed and 101 injured.

In four of the seven cases, the trains involved were derailed. In two cases tank trucks were struck by trains and fire broke out in the wreckage. In one case which occurred at a crossing protected by advance warning signs and bells but having no visual signal devices to indicate the approach of trains, a school bus was demolished, resulting in the death of 14 high-school students and the injury of 15 persons. In another case at a crossing protected by flashing-light signals, a truck driver stopped and waited for one train to pass, then started across, and the truck was struck by a train in the opposite direction, this accident resulting in one killed, 37 injured, and the derailment of a 10-car passenger train, with railroad property damage of approximately $90,000.

In another location where the crossing was protected by advance warning signs and cross-bar signs, an automobile was driven upon the track directly in front of a freight train, the accident resulting in 2 killed, 2 injured, engine and 19 cars derailed, and $30,000 railroad property loss. And in yet another case, an automobile stopped at a stop sign and then was driven upon the crossing as a passenger train was approaching at high speed; apparently the driver experienced difficulty in shifting gears and stopped or nearly stopped on the crossing, the result being 5 killed, 16 injured, 7-car passenger train derailed, and railroad property damage of $37,400.

These accidents indicate some of the current problems in connection with protection of grade crossings and also direct attention to the dangers to trains and to persons on trains as a result of grade crossing accidents. During 1934, 49 trains were derailed in grade crossing accidents and of the total casualties resulting from grade crossing accidents, 18 persons killed and 96 injured were railroad passengers, employees and persons carried under contract. During the first 10 months of 1935, 14 killed and 118 injured in grade crossing accidents were railroad passengers, employees and persons carried under contract; with the reports for November and December still to be tabulated the totals for 1935 will no doubt materially exceed the record of 1934.

Performance of Train Control and Cab Signals

Our inspections of automatic train control and cab signaling in service on the railroads indicate that these systems are in general being maintained in good operating condition. However, in some few cases, due principally to reduced forces and insufficient time devoted to inspection and test of the apparatus in the locomotives, and in one or two cases on account of lax methods and practices resulting from failure properly to supervise this work, conditions of inadequate maintenance of these devices have been disclosed, which resulted, not only in an excessive number of false restrictive operations but also in the occurrence of certain false proceed operations which could and should have been avoided. Excessively frequent false restrictive operations cause unnecessary interference with the flow of traffic, and false proceed operations introduce grave danger of collisions between trains. High standards of maintenance of these devices are necessary not only to comply with the requirements of the Interstate Commerce Commission but also, and of far greater importance, to insure that movement of traffic is not unnecessarily impeded and that the increased safety which these devices are intended to provide is actually secured.

During the past year a number of railroads have taken measures to provide increased stopping distances required for high-speed train operation, and this matter is now under consideration by other railroads. Also, considerable improvement has been noted in the reliability of the whistle device used in cab signaling.

Report on Signaling Practice

C. H. Tillett, Chairman*

The report of the Committee on Signaling Practice included suggestions as to the use of aspects and indications for Rule 284, requisites for a centralized traffic control system, a statement as to the status of automatic train control and continuous cab signaling on the railroads in the United States, requisites for remote control of manual block signals, a set of aspects and indications for four-block systems, and a progress report on signaling for high-speed trains. Abstracts of some of these reports follow:

High-Speed Signaling—In considering signaling for high-speed trains for both light and heavy equipment, giving consideration to the spacing of signals for train operation on grades, curves and tangent track, the committee stated that signal systems may be revised to provide increased stopping distance by (1) relocating signals, (2) eliminating alternate signals, (3) overlapping control of signals, (4) providing duplicate restrictive indications, or (5) increasing the number of restrictive indications.

In presenting this subject subcommittee chairman, H. G. Morgan (I. C.), explained that methods were not listed in order of importance or recommendation on the part of the committee as to the best method to use. E. B. Smith (N. Y. C.) stated that in his opinion methods (3) and (4) should not be used and should not be considered as recommended practice.

Four-Block Signal System—The committee, in considering the assignment to prepare aspects and indications for a four-block signal system, found that such signaling is now in use on two railroads in terminal territory. After giving careful consideration to the aspects and indications now in the Standard Code, the committee recommended the aspects and indications for a four-block system, as shown on the diagram, for use where operating conditions justify, such as in congested terminal territory or on lines with dense high-speed traffic.

In presenting this report subcommittee chairman C. A. Taylor (C. & O.) explained that the committee had been governed by its instruction to prepare aspects and indications for a four-block signal system, based on established practices of the Standard Code rather than to develop an entirely new system of aspects and indications, and that the new aspect of yellow over

* Signal Engineer, Canadian National.

yellow would fit in with existing aspects under Rules 281, 282, 285 and 292.

R. B. Elsworth (N. Y. C.) stated that the new aspects and indications should be designated as "multiple-block" and not as "four block" because of the fact that, as used on certain roads, as for example the New York Central between New York and Buffalo, additional aspects are added at locations as needed to secure adequate braking distances and the system changes from three-block to four or five-block as the necessity arises. The important problem arises in the handling of long heavy freight trains at speeds of more than 50 m.p.h., which require extended distances to reduce speed. E. B. Smith (N. Y. C.) explained that the distance required to reduce train speed from normal to medium speed governed the length of the block and that the explanation of the indication for Rule 282 would make the last sentence of the indication for Rule 285 not only unnecessary but contradictory. The place where an additional aspect is needed is for the speed range between normal and medium. The New York Central determined that in stopping multiple-unit trains from speeds of 35 m.p.h., about two-thirds of the stopping distance was traversed in reducing speed to 30 m.p.h.; that is, if the speed of a train can be reduced to medium before arriving at the next signal no fourth aspect, such as provided for in the proposed rule, is needed. The practice on the New York Central is to introduce an aspect of yellow over yellow indicating "prepare to stop at second signal," and experience has shown this method to be easily understood and advantageous.

G. K. Thomas (A. T. & S. F.) explained that one of the serious handicaps in attempting to fit additional aspects into the existing code rules was that the code was developed with the use of semaphore arms which could not be made to disappear when not needed in an aspect. Now, with the use of light signals, a lamp can be extinguished when not wanted in an aspect, thus resulting in the practicability of developing a very simple system of multiple-aspects. Why have two red lights, one over the other, for the stop aspect, Mr. Thomas asked, when one red light would serve equally as well, and, likewise, why have a green over red to indicate clear when one green lamp will suffice? The Santa Fe proposes to use a very simple system of one red for stop, one yellow for restrictive speed, and one green for clear. At some places there is an occasion for an aspect to afford additional braking distance, and a fourth aspect of yellow over yellow will be used as the first restrictive signal to be encountered by an approaching train, the aspects in succession as viewed by an approaching train being "green, yellow over yellow," "yellow," and red. If a lamp burned out reducing the number of yellow lights, a more restrictive aspect would be displayed, and no checking circuit is needed. Mr. Thomas further explained that such a system was in service in England, in which two yellows means "attention, prepare to find next signal at caution," while one yellow means "caution, prepare to stop."

R. A. Sheets (C. & N. W.) concurred with the committee's recommendation in basing additional aspects on the existing Code rules as a foundation. He pointed out that the railroads are faced with the problems of consolidating terminals and, therefore, aspects should be the same on roads involved.

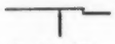
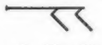
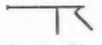
J. P. Muller (B. & M.) explained that the use of green over green as a clear aspect is much better than green over red. The color red penetrates further than green, so that an engineman approaching sees the red light first and if he continues at a high speed too long, expecting to eventually "pick-up" the green, he may not be able to stop. He stated that the series of aspects encountered by an approaching train should taper, "green over green" for clear and then "yellow over green," "yellow over yellow" and then "yellow over red" and finally "red over red." The B. & M. has used these aspects successfully for several years on more than 225 miles of multiple track lines. The wording of the indication proposed by the committee for rule 285 is not applicable because if enginemen obeyed the other indications there is no likelihood of being so governed. In respect to the committee's contention that it felt obliged to base its recommendations on Code practice, Mr. Muller explained that with the exception of Rule 281 the aspects shown do not apply for automatic block signaling but are interlocking signals or manual-block signals. In territory where trains operate at speeds up to 100 m.p.h. he stated that an additional aspect is needed between high speed and medium speed, not in the lower speed ranges.

Subcommittee Chairman Taylor explained the difficulty in attempting to specify rates of speed for the different indications since medium speed in terminal territory would have to be something different from that out on the line, where maximum speeds were as high as 70 m.p.h. to 100 m.p.h.

A. H. Rudd (Penna.) and P. M. Gault (M. P.) criticized the New York Central system of aspects in that a "yellow over yellow" aspect, as they understood, told an engineman what to do at the second signal. R. B. Elsworth (N. Y. C.) explained that their understanding was incorrect, in that the indication and rule definitely gave directions as to what the engineman is to do at the time he encounters this aspect; i. e., "Prepare to stop at second signal."

P. M. Gault (M. P.) made a plea for simplicity of aspects, expressing the opinion that enginemen had serious difficulty in learning the meaning of the more complicated systems of aspects and, as a result, learned only the clear and the stop aspects, seldom using the other aspects to an advantage, his thought being that this may even preclude the use of the simple single yellow caution aspect with any benefit. In other words, as one engineman explained it to another, "if all the boards are horizontal, stop; if any blade is other than horizontal, go ahead, but take it easy."

Subcommittee Chairman Taylor concluded the discussion by explaining that the report was submitted for discussion only and that the committee would welcome further comments, and that the subject would be continued.

Rule 281	Rule 282	Rule -	Rule 285	Rule 292
				
Indication;	Indication;	Indication;	Indication;	Indication;
Proceed.	Approach next signal at not exceeding medium speed.	Approach next signal at not exceeding intermediate speed.	Prepare to stop at next signal. Train exceeding medium speed must at once reduce to that speed.	Stop.
Name - clear.	Name - approach - medium.	Name - approach - intermediate.	Name - approach.	Name - stop.

Intermediate speed.....miles per hour (to be a rate between medium and slow.)

Aspects and Indications for Four-Block Signal System Showing the New Approach Intermediate Aspects as Recommended by the Committee on Signaling Practice

Report on Crossing Protection

A. H. Rudd, Chairman*

The report of the Committee on Highway Crossing Protection included information as to the use of train approach signals of the "stop and go" type, statements as to the development of highway crossing protection, and information concerning federal and state activities in this field. Abstracts of these reports follow:

Train Approach Signals—Existing material in the Manual, Part 159, is to be retained and supplemented with the following: Excerpts from the Manual on Uniform Traffic Control Devices for Streets and Highways—Approved as a code of standard practice by the American Association of State High-

* Chief Signal Engineer, Pennsylvania.

way Officials and by the Fourth National Conference on Street and Highway Safety, approved and adopted for all projects constructed with Public Works highway funds—issued December, 1934.

"Section 325—Traffic control signals shall not generally be used as alternatives to train approach signals except where streets intersect at or close to the railroad crossing, and then only where observance is enforced by police authority. When used, both sides of the track shall be adequately protected by signal faces.

"The signals should show red in all directions when a train is approaching, either by connection to a track circuit or by manual control."

"Section 326—Except under the conditions set forth in Section 325, traffic control signals should not, if avoidable, be installed at a street or highway intersection within 150 ft. of a railroad grade crossing.

"Traffic control signals too close to railroad grade crossings are likely to be misinterpreted by certain drivers approaching from either direction as governing the periods when it is safe to cross the railroad tracks. If the grade crossing is also protected by standard train approach signals, there may be considerable confusion between the two types of signal apparatus so close together.

"If exceptional conditions warrant such an installation, extreme care should be taken in the design and operation to avoid the possibility of forcing vehicular traffic to stop on the railroad tracks."

"Section 389 (in part): The ideal control (of train approach signals) would be such that, regardless of the above mentioned conditions, the signal indications would begin not less than nor much more than 20 seconds before the arrival of the train at the crossing. This would spare motor traffic the annoyance of waiting unduly long for slow moving freight trains, and reduce the number of accidents caused by racing for the crossing. Ideally also no signal indication would be given by a train standing at a station or about to stop before reaching the crossing, or by switching operations in the vicinity except when they passed over the crossing.

"This ideal can be attained only by manual control, and this is recommended at urban crossings where the conditions are as described above. Refinements in automatic control which take some account of speed of approaching trains have been applied at a few crossings. They add greatly to the expense and accomplish their purpose only in part."

A.A.R. Activities: In July, 1935, Bulletin No. 2, standards and recommended practice for railroad highway grade crossing protection, was issued by the Joint Committee on Grade Crossing Protection in which the necessary changes were made to bring it in agreement with the details approved by the Signal Section, and adding under the description of the flashing-light type signal a note reading: "Where permitted or required by governmental authority, a rotating disk bearing the word 'Stop' in reflector lenses may be used instead of the 'Stop on Red Signal,' or the illuminated 'Stop' sign."

In presenting the report, A. H. Rudd (Penna.), committee chairman, explained that the majority of the committee did not favor the use of the rotating disk sign, in conjunction with the standard flashing-light signal, but, in order to take action on the matter, discussion was invited. C. A. Taylor (C. & O.) moved that the sentence regarding the use of rotating disk, as quoted above in the report, be adopted by the Signal Section for submission to letter ballot.

G. A. Dunham (G. N.) made a strong argument in favor of the rotating disk stop sign as an adjunct for flashing-light signals, stating that hundreds of such signals were in service in Minnesota, North Dakota, Iowa, Montana, Idaho and Washington, as well as to some extent in California. Some of these signals have now been in service for nine years, and not only is the protection afforded satisfactory, but the signals have operated as intended and no false clear aspects been reported. He emphasized the fact that the "Stop" aspect displayed by the disk was of a form familiar to all motorists and was, therefore, effective.

He explained that in case of a failure of the power supply or the wiring, the stop aspect was displayed automatically by force of gravity, the same as the basic principle of all railroad signaling, and that, in contrast, such failures at flashing-light signals resulted in a false-clear aspect presented to motorists. He explained that such a failure had resulted in an accident at a crossing protected by flasher-light signals, on an important road.

Chairman Rudd challenged Mr. Dunham to present the evidence in support of his statement and Mr. Dunham replied that the report was a matter of record and referred Mr. Rudd to the report published in the *Railway Age*.

P. M. Gault (M. P.), member of the committee, explained that some signals of the rotating-disk type were in service on his road and that he had personally seen two signals stick clear. These signals were of different manufacture and more than eight years old. He stated that in all his experience he had never seen a flashing-light signal give a false proceed aspect, nor had he been involved in any investigations of accidents concerning such cases. Mr. Gault explained that some 53 different types of crossings signals had, through the past 20 years, been presented to the Signal Section and of these the committee has been able to standardize on two types, the wig-wag and the flashing light, both of which present similar stop aspects, especially at night; i.e., when indicating the approach of a train, the appearance of a swinging red light. He expressed the opinion that the matter before the association was an attempt to legitimize another type of crossing signal.

H. H. Orr (C. & E. I.) expressed the opinion that it was the duty of the association to reduce the number of approved standards to the minimum, and that, if the rotating type is approved by the section, others will be presented for approval.

Chairman Rudd explained that one reason the committee objected to the rotating-disk signal was that this type was manufactured by two companies only, and there was some question whether the Signal Section should adopt a patented device as a standard. He explained in detail the development of the flashing-light signal to show that it was not a patented device. Mr. Dunham stated that the idea of turning the disk was not patentable and that any one can make a mechanism to effect the desired result; the fact that two companies now manufacture such mechanisms does not prevent others from doing so. Mr. Dunham then explained that the disk used on these signals is the same as the national standard STOP sign used on streets and highways, is familiar to motorists and is, therefore, effective.

L. B. Porter (C. M. St. P. & P.) stated that his road has had hundreds of the rotating-disk type of signal in service for several years and that the protection rendered and the operation of the signals were satisfactory, due to the sound basic feature of this type of signal. R. A. Sheets (C. & N. W.) explained that many of the rotating-type signals were in service on the C. & N. W., and that he concurred with Messrs. Dunham and Porter.

R. B. Amsden (I. C.) stated that the divergencies of opinions expressed in the discussion made it evident that the matter should not be put to vote at this time. E. B. DeMeritt (C. of G.) stated that he did not approve of the procedure in that the committee was changing its recommendation from "presented as information" to "approval for inclusion in the Manual." Mr. Rudd agreed that undoubtedly others who favor the rotating-type signal would have arranged to be present if it had been known in advance that this matter was to have been presented for inclusion in the Manual. At Mr. Rudd's suggestion, Mr. Taylor withdrew his motion, and then Mr. Rudd made a motion that a vote be taken to secure the sense of those present as to whether the committee should proceed to prepare drawings and specifications for the rotating-disk signal for presentation at a later date. A count showed that the majority of those present were not in favor of the rotating-type signal.

Federal and State Activities—The Louisiana Highway Commission has issued standard specifications for flashing-light signals at railroad grade crossings, in accordance with standards recommended by the A.A.R. Joint Committee on Grade Crossing Protection and forbidding installations in the center of the highway.

At the 1935 annual meeting it was reported that on December 28, 1934, the Board of Railroad Commissioners of the State of Iowa issued an order Docket K-1269, as to future installations of grade crossing protection. On February 15, 1935, the Board issued requisites for highway-railroad crossing signals. On April 15, 1935, the Board issued revised plan changing rotating stop sign to harmonize with the fixed stop sign contained in the Manual of Uniform Traffic Control Devices for Streets and Highways.

Illinois has revised a portion of the Road and Bridges Act—1935—Article XII—as follows:

"83. Obedience to signal indicating approach of train.

(a) Whenever any person driving a vehicle approaches a railroad grade crossing and a clearly visible electric or mechanical signal device gives warning of the immediate approach of a train, the driver of such vehicle shall stop within 50 ft. but not less than 10 ft. from the nearest track of such railroad and shall not proceed until he can do so safely.

(b) The driver of a vehicle shall stop and remain standing and not traverse such a grade crossing when a crossing gate is lowered or when a flagman gives or continues to give a signal of the approach or passage of a train.

"84. Certain vehicles must stop at all railroad grade crossings.

(a) The driver of any motor vehicle carrying passengers for hire, or of any school bus carrying any school child, or of any vehicle carrying explosives or inflammable liquids as a cargo or part of a cargo before crossing at grade any track or tracks of a railroad, shall stop such vehicle within 50 ft. but not less than 10 ft. from the nearest rail of such railroad and while so stopped shall listen and look in both directions along such track for any approaching train, and for signals indicating the approach of a train, except as hereinafter provided, and shall not proceed until he can do so safely.

(b) No stop need be made at any such crossing where a police officer or a traffic control signal directs traffic to proceed.

(c) This section shall not apply at street railway grade crossings within a business or residential district."

Violation of the above provisions constitutes a misdemeanor and is punishable by a prescribed fine or imprisonment.

Illinois has taken definite action in the matter of protecting a large number of crossings with Federal funds, and the work is under way.

The Public Service Commission of Pennsylvania sent out a questionnaire to the railroads on April 23, 1935, covering a flashing-light signal survey, showing in detail the location of each crossing and detailed information covering the signals, number of train movements of various kinds, maximum speeds, number of tracks, vehicular traffic, pedestrian traffic, etc., and material needed to bring them up to the standards prescribed by the Commission which are those recommended by the A.A.R.

In January, the Public Service Commission of New York State held a hearing on the regulations and practices on the railroads with respect to the operation of signals protecting highway-railroad crossings, and as to delays caused to highway traffic by unnecessary operation of such signals when trains are switching or making other movements not destined to go over the crossing. Representatives of the railroads agreed to investigate the circumstances at each crossing protected by signals, and to institute rules to have a trainman flag the crossing in such cases or to install special control circuits where not too complicated.

New Hampshire has enacted a rule that the expense of providing protection at a highway-railroad crossing is to be shared by the railroad and the state highway funds, on the basis of benefit to be derived by each party, taking into consideration the traffic on the highway as well as the railroad.

Report of Committee on Economics

C. A. Taylor, Chairman*

The report of the Committee on Economics of Railway Signaling included extended statements concerning the cost of stopping trains, the comparative frequency and cost of accidents before and after the installation of automatic block signals, the use of capacitors for power lines, economies effected by modern relays, savings accomplished by the a-c. primary system of power supply, and economics of changing from automatic train control to cab signaling.

Capacitors for Signal Power Lines—The C. M. St. P. & P., by spending $6,925 for capacitors to correct the power factor from 62 per cent to 87 per cent on 104 miles of signal line, effected a saving of $5,247 annually, the net return on the expenditure over and above 6 per cent interest being 100 per cent on the capital investment and 68 per cent on the total cost.

Economics of Modern Track Relays—Tests made on the St. Louis-San Francisco demonstrated that the working current of modern track relays is so much lower than of those purchased in 1910, that the saving in primary battery effected by the new relays effects a saving of 86 per cent over and above 6 per cent interest on the cost of the new relays.

Primary Power Supply for Automatic Interlocking—The Missouri Pacific installed automatic rectifiers in multiple with caustic soda batteries on line and track circuits at an automatic interlocking plant at Vulcan, Ill. Oil lamps on the semaphore signals were replaced with electric lamps continuously lighted. The cost of the change chargeable to capital investment was $1,450, while the gross annual saving was $284.

Economics of Changing from Automatic Train Control to Automatic Cab Signals—The report on this subject explained the saving effected on the Delaware, Lackawanna & Western and the Chicago, Milwaukee, St. Paul & Pacific by changing from automatic train control to automatic cab signals. On the Lackawanna the cost of the change was $11,231, and the net saving $41,452 annually. On the Milwaukee the net cost of the change was $16,635, and the total annual saving effected $6,079.

Cost of Stopping Trains—This report sets forth the measured electrical energy for individual train stops under different conditions on several electrified railroads and as the cost per stop will vary with the cost of electrical energy delivered to the electric locomotive, the cost per stop will necessarily not be uniform in different parts of the country. The wear and tear on brake equipment, damage to lading, damage to car equipment, locomotives, and train delay, will be involved and should be added, and if the stop is made on overtime the extra time lost by locomotive and train crews in making the stop should be added at time and one-half wage rate. Where regenerative braking is in use the amount of energy reclaimed in braking, also the damages avoided by regenerative braking, should be subtracted.

As stated in a note forming a part of the table in the report, from an extensive study made by one railroad, it has been determined that with electrical energy at 1 ct. per kilowatt hour at the locomotive and with coal at $4 per ton on the tender, that the cost per stop with steam or electric locomotive is approximately the same. In detail, this railroad found the cost of energy per stop with electric locomotive to be $1.44 and with steam locomotive for the same train of 2,500 tons, speed 20 m.p.h., to be $1.59 (no regenerative braking).

If crew wages are added, as would be the case if the stop is on overtime, the loss of time of 15 minutes at one and one-half wage rate for the train and engine crew would be about $2.65.

It is not practical to subtract from the kilowatt hour figure for acceleration the kilowatt hours required for the same train running through without stopping, for any such figure would be an approximation. Ordinarily in a through run, energy is applied to the traction motors for something less than 50 per cent of the time when on schedule; thus it would be merely an approximation, if no stop were made, to estimate the amount of energy which would have been consumed between the point where the brakes were first applied and the point at which the train had regained scheduled speed.

Auxiliaries run intermittently. The principal auxiliary affected by the stop is the motor driving the air compressor. Assuming this motor is required to run exclusively because of the stop, to bring the air pressure up to proper level the energy consumption for a passenger train will be approximately 2 kilowatt hours and the cost approximately 2 cents, or something less than 1 per cent of the total energy used and is unimportant when the other variables are taken into account. For a freight train the amount will be greater, depending upon train length and tonnage.

Generally, attempts to develop actual energy costs for stopping a train can be predicated on many bases. The actual energy consumed in bringing the train from stop to scheduled speed, represents approximately the energy dissipated in making the stop. This figure would be different if we attempted to develop what the energy would be had effort been made, after making the stop, to bring the train into the next scheduled station on time, as in addition to the energy required to bring

* Superintendent Telegraph and Signals, Chesapeake & Ohio.

the train from a stop to a normal running speed, it would be necessary to increase the speed of the train, or increase the length of time the energy would have to remain "on" in order to make up the loss of scheduled time. Such a figure would vary so widely with the length of time available between the extra stop and the scheduled time at the next station that the figure would be of no value if it were furnished as it would apply only to the individual case.

Other variables affecting energy consumption are wind, weather conditions, condition of brake equipment, and a number of other details which lead to a wide variation so that the only practical thing to do is to consider the actual energy consumed under certain conditions of curvature, grade, etc., for individual trains.

Recorded Measurements

Kind of train	Loads and empties	Cars	Trailing tonnage	Accelerated from stop to	Time of acceleration	Grade and curvature	K.W.H. for acceleration
Railroad A							
Freight	56L 8E	64	2798	15 m.p.h.	4 min. 30 sec.	+1.66%	280
Freight	56L 8E	64	2918	16.2	4 min. 44 sec.	+1.66%	340
Railroad B							
Passenger	...	7	540	70	1 min. 35 sec.	*Practically level	200
Passenger	...	7	540	70	2 min. 35 sec.	*Practically level	190
Passenger	...	12	865	73	3 min. 40 sec.	*Practically level	230
Passenger	...	11	915	70	4 min. 50 sec.	*Practically level	270
Passenger	...	9	745	70	3 min. 44 sec.	*Practically level	200
Passenger	...	9	745	70	3 min. 10 sec.	*Practically level	230
Passenger	...	13	1070	70	.....	*Practically level	360
Freight	23L 7E	30	1360	34.5	3 min. 57 sec.	*Practically level	80
Freight	23L 7E	30	1360	45.8	5 min. 12 sec.	*Practically level	160
Freight	49L 20E	69	3140	34.5	4 min. 45 sec.	*Practically level	120
Freight	49L 20E	69	3140	43	7 min. 15 sec.	*Practically level	250
Freight	49L 20E	69	3140	34.5	7 min. 46 sec.	*Up 0.2%	250
Freight	49L 20E	69	3140	49	11 min. 6 sec.	*Up 0.2%	470
Railroad C							
Freight	...	50	2500	20	11 min. 6 sec.	*Practically level	144

* Curvature negligible.

Taylor explained that further tests were being made to get data with reference to heavy freight trains, as now being operated on the Pennsylvania and the Norfolk & Western. G. I. Wright (Reading) stated that the cost of starting freight trains, as shown in the report, was considerably higher than shown in a report of the American Railway Engineering Association.

B. J. Schwendt (N. Y. C.) explained that the data given in the reports was accurate and, with one exception, checked with calculations as to draw bar energy required. The data are based on readings of kilowatt-hour meters which had been checked as to accuracy. It is recognized that local conditions and make-up of trains affect the readings and give different results in each case.

Frequency and Cost of Accidents Before and After Installation of Signals—A study has been made, covering a portion of the Denver & Rio Grande Western, for the purpose of determining the comparative frequency and cost of accidents before and after the installation of automatic block signals. The line forming the basis of this study extends between Pueblo, Col., and Midvale, Utah, a distance of 615 miles, of which 126 miles are double track, the remainder, 489 miles, being single track.

The study covered two four-year periods. During the first period, 1923 to 1926, inclusive, trains were operated by the timetable and train order system, no block system being in service; the second period covered the years 1931 to 1934, during which period automatic block signals were in service. During the first period traffic was considerably heavier than during the second period, due in part to increase in size of locomotives and reduction in the number of trains which were operated during the first period in connection with rehabilitation of the railroad.

During the period since the signaling was completed, definite information has been received of several instances in which the automatic block signals have prevented collisions. Furthermore, in the four-year period, 1931 to 1934, inclusive, there were 453 instances of trains being protected and stopped at signals on account of 256 broken rails. Likewise, in this same period, 101 trains were protected by being stopped on account of 79 main-line switches being improperly aligned, the point being open ¼ in. or more. Just how many train accidents have been averted and the probable damage occasioned thereby cannot be determined.

Results of this study are shown in the table, which may be summarized as follows:

During the first period there were a total of 396 accidents which cost $1,112,467. The study indicated that 63 of these accidents, or approximately 16 per cent, costing $260,125, or more than 23 per cent of the total cost of accidents, were preventable by automatic block signals. The averages per year during this period were a total of 99 accidents, costing $278,117, of which 16, costing $62,531, were preventable by automatic block signals.

During the second period there were a total of 94 accidents, costing $151,826. The study indicated that 6 of these accidents,

Statement of Accidents and Costs for a Four-Year Period Before and After Installation A.B.S.

Period	Total all accidents		Accidents preventable by A.B.S.		Cost per mile all accidents		Cost per mile accidents preventable A.B.S.		Cost per million locomotive miles all accidents		Cost per million locomotive miles accidents preventable A.B.S.	
	No.	Cost	No.	Cost	Miles	Cost	Miles	Cost	M.L.M.	Cost	M.L.M.	Cost
1923 to 1926, incl.	396	$1,112,467	63	$260,125	615	$1,811	615	$424	13.17	$347,387	13.17	$79,366
Average per year	99	278,117	16	62,531	615	453	615	106	3.29	86,847	3.29	19,842
Average per accident	...	2,809	..	.....	...	....	...	...	....	.....	....	.....
1931 to 1934, incl.	94	151,826	*6	3,361	615	247	615	5.47	9.19	64,725	9.19	1,460
Average per year	23	37,956	1.5	840	615	62	615	1.37	2.30	16,181	2.30	365
Average per accident	...	1,615	..	.....	...	....	...	...	....	.....	.....	.....

* Signals functioned as intended; rule violations resulting in the accidents.

The minimum cost of making the stop (no regenerative braking), assuming the schedule is not maintained, is represented by the energy put into the train during acceleration to replace that dissipated during deceleration. This is a definite amount of energy which can be read accurately on meters, as shown below, not including regenerative braking where involved.

In presenting the report on the cost of train stops, Chairman

or approximately 6.4 per cent, costing $3,361, or 2.2 per cent of the total cost of accidents, were preventable by automatic block signals. The averages per year during this period were a total of 23 accidents, costing $37,956, of which 1.5 accidents, costing $840, were preventable by automatic block signals.

Had the ratio of total accidents to accidents preventable by automatic block signals, which prevailed during the first period,

also obtained during the second period, the average number of accidents during the second period would have been increased from 23 to 27.4 per year.

During the first period the relatively greater loss resulting from accidents preventable by automatic block signals than from other accidents is shown by this study; 63 accidents preventable by automatic block signals represented an average cost of $4,129, whereas the 333 other accidents in this period averaged $2,559 in cost. The relatively minor character of the six accidents during the second period preventable by automatic block signals but which occurred notwithstanding the fact that automatic block signals were in service, is indicated by the fact that the average cost was only $560.

As a part of this report a series of colored slides were projected on a screen to illustrate several outstanding signaling installations, an explanation being given in connection with each as follows: The use of three-position remotely-controlled telegraph train-order signals on the Erie controlled from the nearest open office eliminate numerous train stops and obviates the use of several forms of train order.

On the Missouri Pacific, an installation of centralized traffic control on 43 miles of single-track effected a 47 per cent increase in average freight train speed and increased gross ton-miles per train hour 57 per cent. On the Pennsylvania, the installation of centralized traffic control on 29 miles of single track effected an annual saving of $50,000, representing 28 per cent on the investment. The traffic included 19 passenger and 11 freight trains daily, and in addition to improving on-time performance for passenger trains, the average speed of freight trains was increased from 16.3 m.p.h. to 30.6 m.p.h. and the gross ton-miles per train-hour increased from 45,709 to 86,558. On the Wabash centralized traffic control installation, the switch at the remote end of the territory, 93 miles from the control point, has given satisfactory service for five years, thus proving that it is practicable to use centralized traffic control for entire operating divisions. On the New York Central installation of centralized traffic control, the freight train speed was increased 36 per cent, thus saving 1.8 minutes per freight train mile. The savings which have accumulated in the eight years during which this installation has been in service total over $2,000,000.

Pictures were then shown of several modern high-speed trains, including the "400" of the Chicago & North Western, the Hiawatha of the Chicago, Milwaukee, St. Paul & Pacific nad the Congressional Limited on the electrified section of the Pennsylvania. The signal engineers of the respective roads explained the changes made in signaling to provide adequate stopping distances on the lines over which these trains are being operated. On the North Western and on the Milwaukee, signals in certain territories were relocated to provide additional braking distances. On more congested territories in the terminal areas, between Chicago and Milwaukee, the North Western has installed multiple-aspect signals, while the Milwaukee is planning to make similar improvements on the sections near Chicago. On the Pennsylvania an entirely new system of position-light signals and continuous cab signaling was installed throughout the territory between New York and Washington, concurrent with the electrification project.

Other Committee Reports

The report of the Committee on Materials Research comprises revisions of three existing specifications, in addition to three new ones covering the following signal apparatus: Dry-process porcelain insulation, No. 6 dry cell for signal and ignition service, copper-oxide caustic-soda cells (Types A, B and C), and air-depolarized dry cells. The committee presented a report on current practice in the use of rust preventatives. A questionnaire on this subject, prepared by Subcommittee B, was distributed among 149 railroads, the report comprising information given in the replies of 68 roads.

The Committee on Designs presented 10 revised drawings for signal equipment superseding previous designs. New drawings of a junction box and crossarm for flashing-light signals were presented for discussion. Drawings covering a suspension base for a five-inch signal mast and concrete battery boxes were submitted for inclusion in the Manual, the latter superseding previous designs and the previous battery-box specifications. Revised information on pipe threads was presented, and a revised specification for one-inch welded wrought-iron pipe was submitted for adoption.

The report of the Committee on Interlocking consisted of revised specifications for the following apparatus: Mechanical interlocking machines with S. & F. locking, electric interlocking machine, electric lock, electric-motor switch operating mechanism, mechanical interlocking machine with Style-A locking, circuit controller for movable bridges, and electro-pneumatic switch operating mechanism. A progress report was submitted on the work of the committee on rail locking devices for interlocking drawbridges. Last year the committee collaborated with representatives of the American Railway Engineering Association in determining the limiting relative position of abutting rails of fixed and draw bridge-spans, and proper tolerances. Although two of the A.R.E.A. committees assigned were not represented at the meeting called for consideration of the subject, the consensus of those present was that the maximum safe tolerances in the relative positions of abutting rails of fixed and movable spans of interlocking swing, lift and bascule bridges should be as follows:

Longitudinal tolerance:
- Without wheel riser device, plus or minus ½ in..... ½ in.
- With wheel riser or other effective device..... 2 in.

Vertical tolerance..... ¼ in.
Horizontal tolerance..... 3/16 in.

These tolerances are based on a report of the A.R.E.A. subcommittee on Track and on the experience of bridge and signal engineers.

The Committee on Automatic Block Signaling submitted two new specifications covering copper-oxide rectifiers and tractive-armature d-c. polarized relays, in addition to revised specifications covering tractive-armature d-c. neutral relays and relay contact post designation plates. A revision and consolidation of existing specifications, entitled Automatic Block Signal System, was presented by the committee as a guide to the engineer desiring to furnish specification for a complete signal system, regardless of the type of power supply to be utilized. This may be used wholly or in part, together with appropriate data, as a basis for contracts providing for new installations. In addition to the specification work, the committee presented revised information for use in calculating a-c. power supply and distribution systems for automatic signaling installations.

Reports were also presented on the following subjects: Alternating-current circuits and apparatus as applied to automatic train-control and cab-signal systems, briefly reviewing the general propositions involved and outlining the bulletins No. 1 to 9 published by the A.A.R. Committee on Automatic Train Control; protection against lightning, relating experience to date with a special signal power-line installation on the Pennsylvania, which includes extraordinary protection against lightning and is regarded by the committee as giving much promise; and an investigation conducted by the committee to determine the effect of locomotive boiler water blow-off on track circuits, for which complete data is given.

The report of the Committee on Contracts and Instructions consisted largely of new and revised instructions for testing and maintaining certain classes of signal apparatus. A revised specification for portable d-c. voltmeters, ammeters and volt-ammeters was submitted. Other new and revised instructions covered the following subjects: Testing electric locking, operation of a-c. track circuits, operation of d-c. track circuits, operation of lead-acid storage batteries; maintaining and testing light signals, electric lamps, car-retarder systems, insulated rail joints and switch circuit controllers. Recommendations concerning principles applicable to the accounting of construction costs for joint signal facilities, use of A.T.C. performance reports, and revision of the general classification of signal interruptions were also included. Chapter XXII—Manual and Controlled Manual Block Systems, for the series American Railway Signaling Principles and Practices, was submitted for discussion.

The Committee on Overhead and Underground Lines presented three new specifications covering bare copper-covered steel line wire and bare copper-alloy line wire (30 per cent conductivity), and bare hard-drawn copper line wire. The committee also submitted progress reports on specifications for line wire, which are in preparation.

N.R.A.A. Presents Excellent Exhibit

Thomas O'Leary,
President

Eighty-five manufacturers join in display of equipment and materials for railway construction and maintenance

C. H. White,
Secretary-Director

FROM Monday morning, March 9, until Thursday afternoon, March 12, the National Railway Appliances Association presented its twenty-fifth annual exhibit of devices and materials employed in the building and upkeep of the fixed railway properties, at the Coliseum, Chicago. Since 1908, this exhibit has been presented simultaneously with the conventions of the American Railway Engineering Association and the Signal Section, Association of American Railroads. Indicative of the diversified nature of these exhibits, they included materials and equipment for use in the construction and maintenance of tracks, bridges, buildings, water service, signals and allied roadway facilities.

The educational value of the exhibit was attested by the fact that the A.R.E.A. incorporated in its program provision for adjournment at 4 o'clock on Tuesday afternoon in order that the members might spend the remainder of that afternoon and the evening at the Coliseum. By reason of the fact that the exhibit was open on Monday, many railway officers spent that day at the Coliseum preliminary to the opening of the A.R.E.A. convention on Tuesday.

These exhibits occupied substantially all of the floor space in the main or central hall of the Coliseum and were so arranged as to provide adequate opportunity for inspection. Not the least of the improvements over previous years was the nature of the decorations. In place of the usual pendant drapery in blue and white, as in former years, the decorations this year in green and white were quiet and dignified; yet they were so disposed as to bring out without exaggeration a sense of the vastness of the great central hall and particularly the height and dimensions of the barrel vaulted ceiling which spans this room. Another feature which created much favorable comment from both visitors and exhibitors was the fact that the displays were remarkably well balanced, none being of a character to dominate either space or interest.

Taken as a whole, the show was demonstrably of high educational value to both ranking engineering officers and those having more local interests. That this value is widely recognized was indicated by the number of roadmasters and supervisors of track, of bridges and buildings and of water service who were in attendance at the suggestion of their superior officers. While no startling improvements or radically new devices were displayed by those companies which had exhibits last year, a number of companies, notably the motor-car manufacturers, were exhibiting for the first time since 1930, for which reason, in several fields, the show was a continuation of last year's object lesson of the advance that has been made in materials and appliances during the last six years.

The officers of the National Railway Appliances Association during the past year who participated in the arrangements for the exhibit were: President, Thomas O'Leary, sales manager, transportation division, western district, Johns-Manville Sales Corporation, Chicago; vice-president-secretary and manager of exhibits, C. H. White, district sales manager, Industrial Brownhoist Corporation, Chicago; treasurer-honorary director, W. Homer Hartz, president, Morden Frog & Crossing Works, Chicago; directors, A. L. McNeill, manager railroad department Okonite Company, Chicago; L. B. Sherman, senior vice-president, *Railway Age*, Chicago; H. H. McDonald, representative, Lorain Steel Company, Chicago; E. D. Cowlin, general sales manager, Eaton Manufacturing Company (Reliance Spring Washer Division), Massillon, Ohio; H. H. Talboys, manager railway sales, Nordberg Manufacturing Company, Milwaukee, Wis. Detailed arrangements for the exhibit were directed by C. H. White, vice-president and secretary of the association.

Annual Meeting

In presenting his report at the annual meeting on March 10, President O'Leary reviewed some of the unusual difficulties which confronted the association during the last year owing to the necessity for reorganizing the board as a result of the death of C. W. Kelly, secretary-treasurer, late in the fall of 1935, and for selecting a new manager of exhibits. "This difficulty," said Mr. O'Leary, "was happily overcome by the selection of C. H. White, vice-president, for this position, as well as that of secretary to fill the unexpired term of the latter office." He also announced that the Board of Directors had created a new office, that of general counsel, and that this position would be made permanent by the adoption of the new by-laws which were up for approval. These by-laws were later approved. The offices of the association are now at 208 South LaSalle street, Chicago.

The treasurer's report showed an expected balance

on hand on April 1 of more than $24,000, as compared with $735 on April 1, 1935, and a total estimated outlay for the year of $27,000.

In the election of officers, Mr. White was not only advanced to president but was also elected secretary; Mr. Cowlin became vice-president, and A. J. Filkins general manager, Paul Dickinson, Inc., Chicago, was elected treasurer; Jess Mossgrove, manager car and haulage department, Austin-Western Road Machinery Company, Aurora, Ill., and W. H. Fenley, western manager, Kerite Insulated Wire & Cable Company, Chicago, were

(*Continued on page 483*)

List of Exhibitors

Adams & Westlake Co., Chicago; relays, signal lamps, lanterns; A. S. Anderson, E. Andrews, U. Hedin, R. D. John, C. H. Larson, D. F. McCarthy, W. A. Smith and H. G. Turney.

Air Reduction Sales Co., New York; oxygen and acetylene, gas welding and cutting apparatus and supplies, literature, demonstration of heat-treating rail ends with 2-flame tip; C. B. Armstrong, J. F. Callahan, C. A. Daley, J. T. Gillespie, Jr., W. A. Handrock, H. A. Hocking, J. W. Kenefic, L. T. McDowell, R. T. Peabody, U. F. Portel, E. M. Sexton, M. M. Weist and D. J. Williams.

American Car & Foundry Co., Chicago; automatic electric steel-bar heater, electric rivet heater, electric metal heaters for heat treating; F. C. Cheston, H. C. Cheston and A. G. Wood.

American Fork & Hoe Co. (Shovel Division), Cleveland, Ohio; shovels and scoops; H. C. Branahl, J. M. Burbank, T. A. Lawson, G. L. McKewin, Frank Reagan and L. H. Turner.

American Hoist & Derrick Co., St. Paul, Minn.; photographs and literature on locomotive cranes, crawler-shovel-crane-dragline, rail cranes, derricks, hoisting engines, revolving derricks, wire rope clips, blocks and sheaves; Arthur Craine, T. C. Hatch, J. L. Hickey, W. B. Maurer, R. D. Payne, S. H. Smith and H. O. Washburn.

Austin-Western Road Machinery Co., Aurora, Ill.; model and moving picture of automatic air-dump car, literature on road machinery and power shovels; S. F. Beatty, Jr., J. D. Benbow, H. B. Bushnell, J. E. Huber, Jess Mossgrove, C. S. Sencenbaugh and Bruce P. Smith.

Automatic Crossing Gates, Inc., Louisville, Ky.; automatic crossing gate, solenoid relay, metal mercury switches, signal cases, crossing bells, gate arm lamps; G. W. Bender, R. G. Clark, M. McD. Dilley, C. T. Hertzsch, E. A. Mann, C. E. Murphy, A. A. Walker and W. F. Weber.

Barco Manufacturing Co., Chicago; stove, gas hammers, tie tampers, flexible pipe joints; William Behlke, W. F. Donaldson, Charles Jenista, C. L. Mellor, F. B. Nugent and N. B. Robbins.

Barrett Co., New York; tar, bituminous road materials and grade crossing materials, samples of prepared and built-up roofing; H. F. Altheide, Walter Buehler, W. F. Doriot, L. J. Drimella, H. R. Hansen, H. F. Klinker, L. O. Pearson, M. J. Rotroff, Charles Stolp, Jr., and H. E. Weeks.

Barrett-Christie Co., Chicago; (Coffing Hoist Co.) hacksaw blades, chain, ratchet lever and gravity lowering hoists; J. R. Coffing, H. N. Hayes, R. P. Kemp.

Buda Co., Harvey, Ill.; diesel engines, track jacks, tie tampers, rail bender, bumping post, car stops, track liners, rerailers, bonding drill, track drill, section and inspection motor cars, track levels, gages, crossing gate, switch stands, tool grinder; H. C. Beebe, R. M. Blackburn, H. S. Brown, E. D. Conant, J. S. Dempsey, R. B. Fisher, J. J. Gard, W. H. Haas, G. W. Hoover, G. A. Secor, L. O. Stratton and E. H. Walker.

Chicago Pneumatic Tool Co., New York; air compressors, electric and pneumatic tie tampers, electric frequency changers, portable, pneumatic and electric track tools, pneumatic and electric portable tools and pneumatic and electric bridge tools; H. G. Barbee, P. J. Christie, C. B. Coats, S. A. Congdon, Jr., H. R. Duebel, L. F. Duffy, A. H. Gerald, T. P. Harris, F. J. Jobst, G. C. Vanden Boom and L. J. Walker.

Chipman Chemical Co., Inc., Bound Brook, N. J.; chemical weed killer; J. K. Aiman, R. N. Chipman, J. D. Ruttan and J. Sandburg.

Cleveland Frog & Crossing Co., Cleveland, Ohio; frogs, crossings, switch accessories; J. A. Donahey, E. W. Goodaire, L. G. Parker, G. A. Peabody and H. I. Prentice.

Conley Frog & Switch Co., Memphis, Tenn.; models of expansion joints, turntable joints and self-guarded manganese spring frogs; E. H. Baumgarten, J. C. Conley, J. E. Conley and F. G. Dunbar.

Crerar, Adams & Co., Chicago; rust preventive, portable hydraulic units, jacks and presses, felt and brushes, hand split handles for track tools, pull lift hoist, die starter, sheet metal screws, track jacks, track and bonding drills, pipe pushers, demolition tools; pipe bender, knockout punches, pipe and machinist wrenches; R. J. Arehart, G. J. Doyle, Robert Ferguson, Adolph Hawkinson, E. C. Poehler, Irving Poehler, Paul Rabe, J. K. Stewart, J. M. Temple and T. F. Tough.

Cullen-Friestedt Co., Chicago; anti-slip rail tong, moving pictures of rail crane, clamshell and lifting magnet; K. J. Beller, W. C. Bamber, L. B. Bertaux, C. J. Bronez, E. V. Cullen, F. J. Cullen, F. P. Cullen, T. G. Frazee, G. H. Goodell, R. W. Jamison, J. F. Leonard and A. F. McCoole.

Dearborn Chemical Co., Chicago; water treating equipment, pumps, chemicals, rust preventives, water testing equipment, chemical proportioning pumps, signal foam-meter, process for corrosion prevention; G. R. Carr, O. W. Carrick, E. M. Converse, Joseph Cremmer, H. B. Crocker, E. A. Goodnow, L. O. Gunderson, W. H. Hinsch, C. M. Hoffman, F. B. Horstmann, S. C. Johnson, F. Liggett, R. Q. Milnes, A. Moeller, S. C. Moore and C. C. Rausch.

DeSanno & Son, A. P., Inc., Philadelphia, Pa.; abrasive wheels and abrasive cutting machine, literature; L. E. Buckingham, R. A. Burton, L. N. Mills, J. C. Rinehart and E. J. Rohan.

Paul Dickinson, Inc., Chicago; smoke jacks, chimneys for small buildings, roof and deck drains, roof ventilators (full size and models); A. J. Filkins.

Duff-Norton Manufacturing Co., Pittsburgh, Pa.; track jack, automatic lowering jacks, ball-bearing self-lowering jacks, standard jacks, built-in air-motor-operated power jacks, drift bolt puller, sidelift track jack, journal jacks; D. E. Evans, J. Gilchrist, G. C. Hutchinson, A. Roberts, C. N. Thulin and E. E. Thulin.

Eaton Manufacturing Co. (Reliance Spring Washer Division), Massillon, Ohio; spring washers, rail bonding washer; E. D. Cowlin, E. C. Gross, R. L. Shireman and A. H. Weston.

Elastic Rail Spike Corp., New York; rail fastener, fatigue testing machine; W. A. Fisher, A. C. Jack and B. Kuckuck.

Electric Tamper & Equipment Co., Ludington, Mich.; electric vibratory tampers, tooth-tip tamper blades, electric generator sets, vibrators for concrete placement, literature; J. H. Callahan, G. E. Cartier, V. G. Cartier, H. W. Cutshall, Corwin Jackson, E. R. Mason and G. L. Walters.

Evans Products Co., Detroit, Mich.; model of auto-stop, rail-highway truck, motion pictures; J. M. Evans, A. B. Hayes, W. Ward Mohum, O. G. Moore, A. V. Owen, F. L. Seeley and Era Summar.

Fairbanks, Morse & Co., Chicago; water crane, tank fixtures, motor-driven displacement pump, centrifugal pumps, Diesel engines, platform and dial scales, scale beams, parts for motor cars, magneto, heavy and light section cars, patrol cars, electric motors, axle-lighting generators for air conditioning, turbine pumps, gas-driven generator set, stoker; L. T. Allis, W. F. Anderson, D. L. Arnold, E. P. Chase, R. V. Cook, E. J. Coverdale, J. F. Cruikshank, C. T. Fugitt, E. C. Golloday, W. R. Grant, H. L. Hilleary, E. F. Kultchar, R. F. Lane, D. K. Lee, C. G. Mahana, W. L. Nies, C. B. O'Neil, C. A. Rauch, H. E. Vogel, C. H. Wilson and William Yadon.

Fairmont Railway Motors, Inc., Fairmont, Minn.; gang cars, standard section cars, inspection cars, light section cars, inspection coach, bridge and building cars, heavy duty cars, photographs of weed burners, ballast drainage cars, ballast cleaner; G. Adams, C. P. Benning, C. W. Brhel, W. D. Brooks, K. K. Cavins, C. J. Dammann, W. G. Day, D. E. Doolittle, A. R. Fletcher, L. M. Granger, R. W. Jamison, C. H. Johnson, W. F. Kasper, J. T. McMahon, V. Pagett, R. W. Payne, H. W. Protzeller, J. E. Simkins, H. A. Sly, H. M. Starrett, H. E. Wade, L. D. Whitaker, and W. M. Williamson.

Fansteel Metallurgical Corp., North Chicago, Ill.; rectifiers, transformers for signal service, tantalum carbide cutting tools and dies; James Hall and C. G. Howard.

General Electric Co., Schenectady, N. Y.; illuminated photographs of maintenance of way welding equipment; C. C. Bailey, W. M. B. Brady, C. Dorticost, W. G. Ferguson and L. W. Shugg.

Gould Storage Battery Co., Depew, N. Y.; batteries for railway signal, telephone, interlocking, telegraph and car retarders, dispatch systems—kathanode plastic and dreadnaught types; A. M. Anderson, E. W. Breisch, W. H. Burkey, S. E. Gane, E. T. Kopper, U. V. McMillan, J. L. Rupp and J. C. Sykora.

Hayes Track Appliance Co., Richmond, Ind.; bumping post, wheel stops, derails, derail operating stand; J. R. Harris, S. W. Hayes, H. J. Mayer and P. C. McClure.

Hollup Corp., Chicago; gas-driven electric welding outfits, welding hand shields and helmets, motor-driven 300-amp. arc

welding set, welding rods, literature, belted generator; R. C. Barr, Ray Bender, A. Bernard, A. M. Candy, O. L. Howland, R. B. Monroe, W. S. Palmer, W. C. Pearson and George Rohder.

Hubbard & Co., Pittsburgh, Pa.; track tools, nut locks; J. F. W. Kruse, L. J. Wenzel and John Wincrantz.

Industrial Brownhoist Corp., Bay City, Mich.; moving pictures of ballast cleaner, car dumper and locomotive crane; Thurman Frazee, Hoyt Hayes, A. P. Lyvers and C. H. White.

Ingersoll-Rand Co., New York; crawler-mounted compressor—8 tool, railway-mounted compressor—4 tool, spot tamper, tie tampers, pneumatic tools, rock drills and mining tools, bridge and building tools; W. H. Armstrong, G. E. Bridge, G. A. Gallinger, W. J. Heinz, R. H. Johnson, L. A. Luther, G. W. Morrow, T. H. Weigand and D. W. Zimmerman.

Ingot Iron Railway Products Co., Middletown, Ohio; multiplate arch, paved invert pipe, perforated subdrain pipe, metal cribbing, metal tunnel (plate) liners, spiral welded pipe; R. Y. Barham, E. L. Brown, E. T. Cross, C. N. Crout, William Fraser, W. P. Greenawalt, S. R. Ives, I. E. Jones, W. J. Kelly, dorff, W. H. Fenley, J. A. Hamilton, H. J. Harrel, C. A. Reeb, J. A. Renton, A. H. Smith and J. W. Young.

Lehon Co., Chicago; prepared roofing, asphalt shingles, asbestos shingles and roof coatings; S. Campagna, Frank Carpenter, John Eipper, J. W. Shoop and H. A. Wolfe.

Locomotive Finished Material Co., Atchison, Kan.; alloy steel self-guarded frog, model of cast iron crossing, adjustable rail brace, adjustable guard-rail block; R. L. McIntosh, A. H. Moorhead, H. E. Muchnic and G. W. Taylor.

Lundie Engineering Corp., New York; tie plates, rail and flange lubricator; L. V. Armstrong, C. E. Irwin, W. B. Joyce and O. W. Youngquist.

MacRae's Blue Book Co., Chicago; copy of publication; F. J. Canavan, W. P. Dent, B. E. Haynes, J. H. Hibbard, C. Hill, R. S. Jaquith, J. W. Palmer, S. M. Prazak, F. O. Rice, J. H. Robinson, S. Simonson, R. C. Taylor and C. S. Wallace.

Machinery & Welder Corp., Minneapolis, Minn.; arc welding equipment; H. C. Close, A. Craine, F. E. Dunlap, F. P. Kohlbry and R. L. Kohlbry.

Magnetic Signal Co., Los Angeles, Cal.; photographs of high-

The Exhibit Was Unusually Attractive in Decoration and Arrangement

M. C. Patton, N. A. Powell, A. W. Spaulding, W. H. Spindler, R. S. Stimson, J. R. Wilks and J. L. Young.

Johns-Manville Corp., New York; transite conduit, roofing, transite pipe, transite smoke jack, asphalt mineral-surface bridge plank, full line of fireproof-building materials, insulation, friction materials, refractories, asphalt tile and cork flooring, soft mechanical packings; P. R. Austin, C. E. Bryant, C. S. Clingman, J. D. Johnson, Thomas O'Leary, Jr., A. C. Pickett, H. R. Poulson, W. W. Prosser, R. P. Townsend, J. H. Trent and E. H. Wells.

O. F. Jordan Co., East Chicago, Ind.; model of Jordan spreader; A. W. Banton, J. C. Forbes, W. E. Kasten, H. M. McFarlane, W. J. Riley and C. W. Shipley.

Joyce-Cridland Co., Dayton, Ohio; track jacks, bridge jacks, car jacks, locomotive jacks, bus jacks; Huston Brown, B. C. McDonald, Fred Rix and W. E. Webster.

Kalamazoo Railway Supply Co., Kalamazoo, Mich.; heavy and light-duty motor cars, pressed steel and wood center motor car wheels, track gage, level, section of gas engines; L. W. Bates, L. Boswell, R. E. Keller, F. E. McAllister, P. J. Robischung and K. B. Sylvester.

Kerite Insulated Wire & Cable Co., Inc., New York; insulated wire and cables; E. L. Adams, E. M. Branchfield, C. M. Dearway crossing signal, photographs of illuminated stop sign for crossing signal, portable sanitary drinking fountain, magnifying mirror rail inspector; Laurance Boswell, D. F. Hilton, R. W. Payne, H. W. Renick and J. V. Wescott.

Maintenance Equipment Co., Chicago; rail and flange lubricator, switch-point protector, blue-flag derail, picture of three-man rail layers, samples of graphite base lubricants; S. E. Bates, D. M. Clarke, A. J. Frystak, E. Overmier, T. E. Rodman, R. J. Shanahan and G. L. Springborn.

Mall Tool Co., Chicago; 5-hp. gasoline rail grinder, cross slotting attachment, 3-hp. electric rail grinder, nut-setting attachment, 16-hp. rail grinder, rail drill, corrugation grinder; Richard Clifton, Merle Elrick, Charles Frame, William Garbouch, J. W. Innes, F. E. Kilbourn, A. W. Mall, F. McGonigle, F. Mortensen, M. Rehnquist, William Sanders, R. Schwass, and Peter Walzak.

Mallory & Co., P. R., Indianapolis, Ind.; rectifiers for track and signal work, rectifier for direct operation of crossing signals, condensors, switches, vibrators for operating neon signs from direct current, welding tips and electrodes; E. A. Lundy, H. R. Mallory and W. L. McMichael.

Metal & Thermit Corp., New York; pressure welding equipment for rail joints, pressure and compromise weld joints; J.

H. Deppeler, Anton Lucas, J. B. Tinnon, H. T. Thompson, L. G. Vock and C. D. Young.

Morden Frog & Crossing Works, Chicago; manganese insert frog, taper rail, compromise joint, adjustable rail brace, foot guard, reflex switch lamp, switch accessories; E. C. Argust, R. A. Brown, W. Homer Hartz, G. F. Kilmer, Lyle Martin, C. E. Murphy and S. S. Withrow.

Morrison Railway Supply Corp., Buffalo, N. Y.; Osmose wood preservative, grinding wheels, oil burning preheater, welding rods, switch point guard, literature on welding service; G. J. Diver, M. B. Morrison, R. L. Morrison and E. Smith.

National Carbide Sales Corp., New York; acetylene light and lantern, carbide, carbide flare light, motor car headlight; R. C. Holcomb.

National Carbon Co., Inc., New York; dry cell batteries, flashlight cells, flashlight cases, high-voltage signal cells, anti-freeze and anti-rust compounds, air-cell batteries; Ernest Cordeal, J. S. Gemmell, D. H. Green, R. L. Hasbrook, F. C. Henderson, M. D. Rees and F. J. Wolfe.

National Lead Co., New York; metallic paint and allied products, expansion bolts; J. O. W. Belt, W. S. Carlisle, F. M. Hartley, Jr., F. W. Maynard, Hugh Millen, O. Meyer and A. H. Sabin.

National Lock Washer Co., Newark, N. J.; spring washers, ferrule wedge for tool handles; F. B. Archibald, George Goodell, W. R. Hillary, C. H. Loutrel, G. LaRue Masters, A. W. Preikschat, W. H. Reaves, S. H. Smith and G. E. Webster.

Geo. P. Nichols & Bros., Chicago; model of transfer table, duplex control for turntables; B. Goldman, S. F. Nichols and G. M. Shearer.

Nordberg Manufacturing Co., Milwaukee, Wis.; surface grinder, utility grinder and accessories, lag-screw driver, track drill, adzing machine, power jack, spike puller, power track wrench, precision grinder; C. P. Clemmens, W. W. Fitzpatrick, C. K. Jensch and H. H. Talboys.

Okonite Co., Passaic, N. J.; insulated wires and cables, friction tape, rubber splicing compound, oil-o-static transmission system; R. N. Baker, A. L. McNeill, E. H. McNeill, J. J. O'Brien, J. D. Underhill, F. J. White and R. B. Zane.

Oxweld Railroad Service Co., Chicago; welding equipment, samples of welded rail, switch points and pipe, compromise joints, samples of Stillite in track equipment, flood lights, heat-treated joint; Lem Adams, M. C. Beymer, G. P. Bogert, M. Burnett, Jr., W. E. Campbell, E. Cordeal, W. E. Donalds, F. J. Duffie, C. J. Gavin, F. G. Graham, F. C. Hasse, R. J. Heaney, W. D. Hoffman, W. A. Hogan, H. W. Kofmehl, J. W. Lacey, William Leighton, F. H. Lurquin, G. B. Moynahan, D. H. Pittman, E. S. Richardson, J. H. Rodger, L. C. Ryan, H. W. Schulze, J. C. Stephenson, F. C. Teichen, J. E. Winslow and L. A. Woodward.

Pettibone Mulliken Co., Chicago; high switch stands, switch-point lock, model and full-size permanent-base crossing, spring nuts, gage plate; J. H. Asselin, W. A. Bergstrom, C. A. Johnson, C. Lambert, George Lyman and G. J. Slibeck.

Pocket List of Railroad Officials, New York; copies of publication; J. Alexander Brown, Harold A. Brown and B. J. Wilson.

Pomona Pump Co., Pomona, Cal.; deep-well turbine pump; H. P. Barton, G. W. Clucas, C. C. Cook, R. J. Ernst, H. W. Ross and J. W. Johnson.

Portland Cement Association, Chicago; model of 3-pile concrete trestle, track stabilization full-size model, a butt of a 50-ft., 24-in. octagon pile, motion pictures of installation operations; F. W. Capp and A. C. Irwin.

Power Ballaster Co., Chicago; working model of power cribbing machine, motion pictures; H. K. Christy, V. Coble, Hobart Newman and F. H. Philbrick.

Pyle-National Co., Chicago; full automatic gas electric set, turbo generator, locomotive headlights, floodlights, full line of plug and receptacles, portable hand lamps, miscellaneous electrical conduit fittings; J. A. Amos, J. V. Baker, F. M. Currie, W. H. East, G. E. Haas, W. Miller, W. A. Ross, R. C. Vilas and W. A. Wulle.

Q & C Co., New York; switch-point guard, derail, gaging tool, gage rods, rolled steel compromise joints, alloy steel compromise joints, guard rail clamp, safety rail tongs, rail and flange oiler, electric snow melter; G. H. Goodel, L. E. Hassman, E. R. Packer, J. L. Terry and Lewis Thomas.

Rail Joint Co., New York; standard and insulated joints, controlled or intermittent bearing joint, armored insulated joint, alloy compromise joints, tight center joint; W. J. Acker, V. C. Armstrong, Alex Chapman, E. A. Condit, W. E. Gadd, H. C. Hickey, G. H. Larson, J. N. Meade and E. F. Schermerhorn.

Railroad Accessories Corp., New York; power track machines for tightening and loosening nuts and setting screw spikes, moving pictures of track machines in use, tie borer, hand bonding drill; S. G. Ellis, F. C. Lavarack, B. A. Lundy and F. F. Seeburger.

Rails Co., New Haven, Conn.; tie plate and rail fastener, screw spikes, cut spikes, oil, electric and gas snow melters, rail, flange and curve lubricator, crossing flangeway bracket; T. G. Dalton, F. J. Forster and L. T. Burwell.

Railway Age-Railway Engineering and Maintenance, New York; copies of publications; G. E. Boyd, M. H. Dick, J. H. Dunn, S. O. Dunn, O. C. French, L. R. Gurley, S. W. Hickey, N. D. Howard, E. T. Howson, F. C. Koch, W. S. Lacher, Henry Lee, J. G. Little, H. E. McCandless, H. H. Melville, H. A. Morrison and L. B. Sherman.

Railway Purchases and Stores, Chicago; copies of publication; J. P. Murphy, Jr., and K. F. Sheeran.

Railway Track-Work Co., Philadelphia, Pa.; portable reciprocating track grinder, portable stock-rail grinder, electric track grinder, rail-joint cross grinder, portable track grinder, samples of abrasives, literature; H. M. Moorhead and A. M. Nardini.

Ramapo Ajax Corp., New York; Racor Pacific Frog & Switch Co., Los Angeles, Cal.; safety switch stands, rigid switch stands, improved switch points with undercut stock rail, adjustable and standard rail braces, vertical compensating switch rods, switch clips, Racor rail lubricator. Racor selective process heat treated rail; T. E. Akers, W. Bender, G. A. Carlson, G. M. Cooper, J. E. Davidson, R. E. Einstein, H. Hazelton, D. F. Hilton, P. Hoffman, A. F. Huber, J. S. Hutchins, R. W. Payne, W. A. Peddle, W. Perdue, H. W. Renick and J. B. Spencer.

S. E. Rawls Co., Streator, Ill.; track mower, motor scythe, scythe clamp; C. F. Butts, E. J. Jaeger, Mertz Rawls and S. E. Rawls.

Sellers Manufacturing Co., Chicago; wrought iron tie plate, universal tie plate, angle bars rolled from steel axles; J. T. Flynn, W. L. Helliwell, G. M. Hogan, A. F. McCoole, R. J. Platt, S. H. Smith and R. A. Van Houten.

Syntron Co., Pittsburgh, Pa.; electric tie-tamper, cross sections of electric tie tampers; D. G. Black, J. F. Chandler and J. A. Roche.

Taylor-Wharton Iron & Steel Co., Easton, Pa.; No. 10 spring rail fog (130-lb.) equipped with shock absorber, manganese welding rod, models and circulars of standard equipment; C. M. Griffith, R. C. McCloy, W. G. Hulbert, H. B. McDermott and H. F. McDermott.

Teleweld, Inc., Chicago; joint shim, samples of welded joints, heat-treated joints, gasoline rail pre-heater, bridge welding sample, Brinnel-hardness tester, electric welding rod; T. L. Borman, G. A. Greene, H. E. McKee, D. G. Kerwin, W. A. Peck and Stanley H. Smith.

Templeton, Kenly & Co., Ltd., Chicago; track end bridge jacks, rail pullers and expanders, tie spacer; W. C. Comer, R. B. Hill, G. L. Mayer and J. B. Templeton.

U. S. Wind Engine & Pump Co., Batavia, Ill.; water-column, valves, switch stands, semaphore switch stands, float valves, models of water tanks and towers; H. Beem, R. C. Carlson, J. P. Prindle, E. Schumacher, LeB. Turner and C. E. Ward.

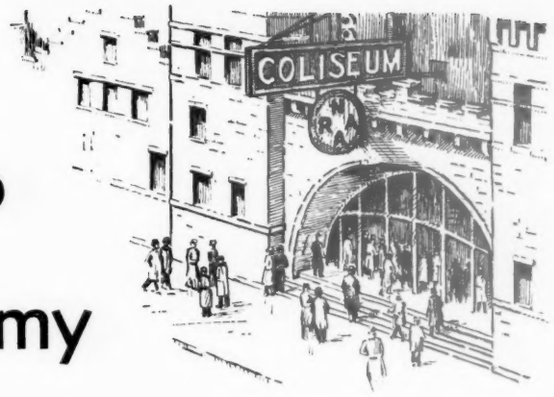
Western Railroad Supply Co., Chicago; inductor contact, flashlight crossing signals, wigwag signals, revolving-banner signals, crossing bells, semaphore lamps, gate lamps, switch lamps, motor car spotlight, reflectorized signs, lightning arresters, annunciators, electric meters, signal accessories; H. M. Buck, Theodore H. Cole, W. Dinnerville, L. V. Dolan, S. M. Dolan, C. G. Elliott, Frank Faeth, Godfrey Gort, John Hensel, Harold Jones, J. N. Meade, S. Miskelly and S. H. Smith.

Woolery Machine Co., Minneapolis, Minn.; light-weight motor car, display of weed burner photographs; A. J. Franke, John Haw and H. E. Woolery.

Non-Exhibiting Members

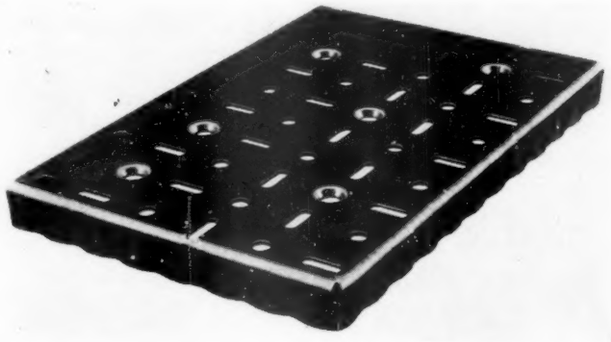
American Chain Co., Bridgeport, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Caterpillar Tractor Co., Peoria, Ill.
Cleveland Tractor Co., Cleveland, O.
Corning Glass Works, Corning, N. Y.
Detroit Graphite Co., Detroit, Mich.
DeVilbiss Co., Toledo, Ohio.
Frog Switch & Mfg. Co., Carlisle, Pa.
General Railway Signal Co., Rochester, N. Y.
Inland Steel Co., Chicago.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Locomotive Firebox Co., Chicago.
Massey Concrete Products Corp., Chicago.
National Aluminate Co., Chicago.
North Western Motor Co., Eau Claire, Wis.
P. & M. Co., Chicago.
Pittsburgh Plate Glass Co., Newark, N. J.
Railway Maintenance Corp., Pittsburgh, Pa.
Republic Steel Corp., Youngstown, Ohio.
Union Switch & Signal Co., Swissvale, Pa.
U. S. Steel Corp., New York.
Warren Tool Corp., Warren, Ohio.
Weir, Kilby Corp., Cincinnati, Ohio.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

Manufacturers Offer New Aids to Efficiency and Economy



New Bethlehem Steel Paving Plates

TWO new types of protective wearing plates for concrete floors and paving, designed for installation on the surface of the concrete to which they are anchored to form an integral part, have been placed on the market by the Bethlehem Steel Company, Bethlehem, Pa. These new plates, which are designated Bethlehem Steel Paving Plates, are made from ⅛-in. rolled steel in standard sections 18 in. long by 12 in. wide, and are fabricated with turned-down edges on all four sides, 1½ in. deep, which are crimped to give the plates firm anchorage in the concrete.



A Section of Flooring Plate Showing the Countersunk Holes to Receive the Flat Head Anchor-Bolts

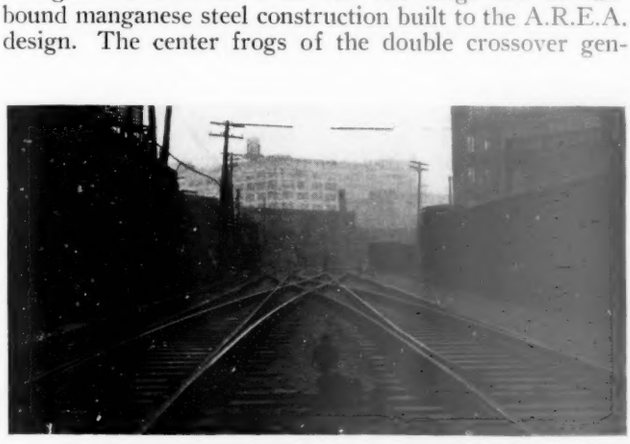
One type of plates is intended primarily for use on roadways, bridge decks and trucking ways where large diameter wheels are the rule, while the other type is intended primarily for installation on heavily used floors and platforms where small wheel trucking equipment is used and where trucking speeds are not high. The difference in the two types is largely in the surface provided. Both have a pattern of interspersed elongated and circular holes, but in the case of the plates for use on roadways, the circular holes are provided with anti-skid buttons or with anchor bolts with button-type heads, while in the case of the plates for floors, the circular holes throughout are provided with anchor bolts, the heads of which are countersunk beneath the surface of the plates. Thus, the one type of plate presents a rough non-skid surface, the projecting buttons of which are made of a special-analysis wear-resisting steel, while the other type of plate, while somewhat resistant to skidding as a result of the surface openings, is essentially smooth. The anti-skid buttons of the roadway plates have short shanks and are welded to the plates, while the button-head type anchor bolts used with these plates, and also the countersunk-head type anchor bolts used with the smooth-top flooring plates, have long shanks, notched on the sides, which provide firm anchorage of the plates to the concrete, supplementing the anchorage afforded by the crimped edges of the plates.

Both types of plates are designed to be installed when the concrete paving or flooring is laid. While the concrete is still soft, the plates are pressed into position to a solid bearing, and the anchor bolts are pushed into place. It is said that the resulting paving on flooring will withstand severe impacts without damage, and is practically indestructible so far as wear is concerned.

Special Trackwork of GEO Construction

AN interesting and complicated installation of special trackwork, involving GEO construction, has been made by the Chicago, Milwaukee, St. Paul & Pacific at the west end of its union depot at Milwaukee, Wis. This installation consists of one No. 10 double crossover, two tandem turnouts, one No. 11 special guarded turnout, and two No. 11 special turnouts, all installed on curved main track.

The rails used in this installation are of 151-lb. R. E. section and, except in point-rail sections 175 and 418, are given a cant of 1 in 40. All frogs are of rail-bound manganese steel construction built to the A.R.E.A. design. The center frogs of the double crossover gen-



View of the Special Trackwork Installation of GEO Construction on the Milwaukee

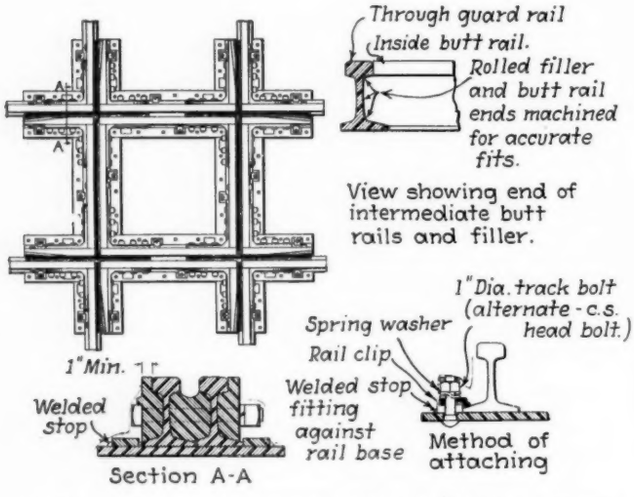
erally follow A.R.E.A. design No. 767, and the end frogs are of the self-guarded type.

GEO tie plates with complete clamp and bolt fasteners are employed throughout the installation. These are 7-in. wide and are made of copper-bearing steel. All tie plates, except the slide plates directly under the switch points, are provided with shims. The extra thick slide plates are shaped to fit over the inner base of the stock rail, thus providing a hold-down and affording a full-flange bearing for the point rail for its entire length. Special slide plates for the stock rails provide for a wedging rail against riser plate shoulders. These slide plates are provided with special clips to permit removal or replacement of stock rails without disturbing the slide plates.

All necessary material for this installation, including the rails, was furnished by the Carnegie-Illinois Steel Corporation.

Heat-Treated Rail Crossings

THE Ramapo Ajax Corporation, New York, is now building its "100%" bolted rail crossings with selective process heat-treated rails, which, in combination with certain other improved features, is said to more than double the life of the new crossings over



Sketch Plan of the Heat-Treated 100% Bolted Rail Crossings, With Certain Details

standard bolted rail crossings. The heat-treated rails used in the new crossings are said to have a head hardness 30 per cent higher than found in ordinary untreated rail, which greatly increases their resistance to abrasion and impact. At the same time, it is said that the rail used, the base of which is annealed, has, under drop test, shown more than 50 per cent greater ductility than ordinary rail, minimizing the possibility of failure due to breakage.

In the new heat-treated rail crossings, easer and corner straps, which are combined in one piece, are of high-carbon forged heat-treated steel, and the through rails are furnished with high-carbon heat-treated fillers, machined for accurate fit against the head, web and base. The butt rails of the crossings are furnished with rolled steel fillers, continuous on the inside of the crossing, and machined on the ends for accurate fit against the guards. Continuous base plates are provided preferably in line with the heavier traffic, and both the long plates and the filler base plates are held in position by means of welded stops and rail clips. All bolts in the crossings are of high-carbon steel, heat-treated.

Aluminum Paint for Creosoted Timbers

AN aluminum paint for application to the surfaces of creosoted timbers is being marketed by the Koppers Products Company, Pittsburgh, Pa. This product, which is known as Lumino Aluminum Paint, is a chemically processed tar base paint and is applied without a sealer. While this paint may be applied by hand with brushes, it is pointed out that by spraying the paint on, a more uniform coating is obtained without "working up" creosote from the surface. For brush application it is recommended that brushes four to six inches wide with bristles approximately five inches long be used. Application of the paint with brushes, it is said, should be made with as few strokes as possible.

In order to secure successful results with this paint importance is attached to the necessity of allowing the timber a sufficient period of seasoning after treatment. This seasoning may be obtained after the material is installed or it may be accomplished by stacking the creosoted wood in open piles allowing the free access of air to all surfaces. Seasoning periods of not less than three months of summer weather in the south and of not less than five months of summer weather in the north are recommended.

Portable Engine Coaler

A NEW portable engine coaler and a hopper car unloader, which are designed to take coal from bottom-dump cars and transfer it directly to an engine tender on the adjacent track, have been introduced by the Ross and White Company, Chicago. The coaler, known as the direct "Red Devil" portable engine coaler, has a capacity of 60 to 80 tons per hour. It has a length of 30 ft. from end to end of the loading boom and is mounted on two 36-in. roller-bearing wheels. Under its own power the coaler may be moved forward, backward or rotated, and the loading boom may be raised and lowered between the loading and clear positions.

The conveyor in the coaler is carried in a truss boom and consists of drag bars of malleable castings, 4 in. high and 16 in. long, the ends of which are cast integral with

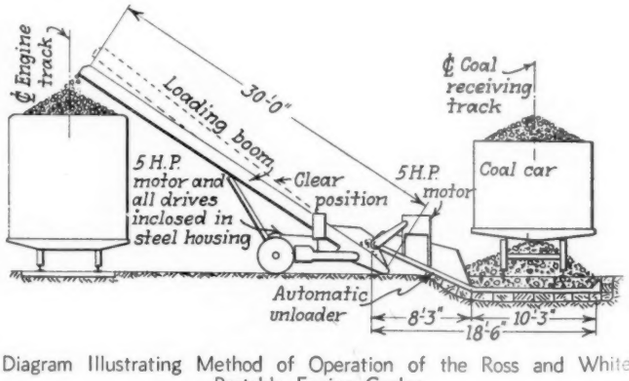


Diagram Illustrating Method of Operation of the Ross and White Portable Engine Coaler

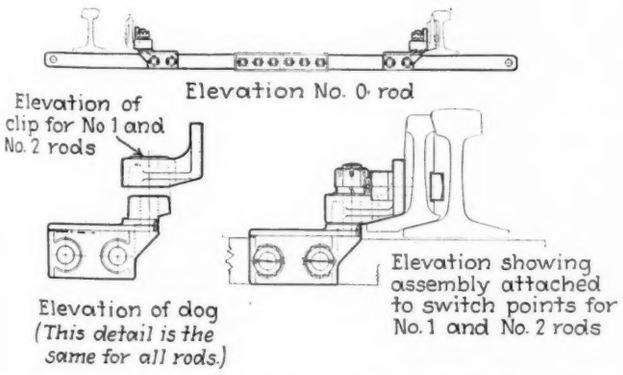
links in two endless chains that drag the bars along the steel plate bottom of the trough. For operating the conveyor, a 5-hp. power plant is required which may consist of an electric motor or a gasoline engine, as desired. An operator's platform is provided on the coaler and all movements are controlled by four levers. It is pointed out that when backed into a stock pile of coal the engine coaler becomes self-loading. If desired, the coaler may be furnished without the self-propelling feature and without the necessary mechanism for raising and lowering the boom; in which event a hand-operated worm-gear winch is provided for changing the position of the boom.

The coal car unloader that is used in connection with the engine coaler is installed in a timber-lined slot under the track from which the coal cars are unloaded. By means of 20-in. cast steel drag bars on 12-in. centers, the coal that falls into the slot from the hopper car is dragged from beneath the car and discharged onto the lower end of the conveyor on the coaler. The unloader also requires a 5-hp. power plant. A variation of this unloader is mounted on wheels for operation without a pit but, with this arrangement, the unloader must be removed from the track during the shifting of the coal cars. While the coaler and unloader described above are designed for use with about 39-ft. track centers they may also be used where the track centers are less by placing the coaler in a diagonal position and using a side discharge chute.

Racor Vertical Compensating Switch Rods

THE Ramapo Ajax Corporation, New York, has developed what it terms Racor Vertical Compensating Rods for switch installations, which are designed specifically to provide rigid support for switch points without increasing the force required to operate the switch, and, at the same time, to eliminate rapid wear in switch fastenings. The essential features of the new rods are that they are installed with their broad faces vertical, and are equipped with stout, yet flexible, clips. The clips are of the swivel type with large bearing area, and are attached to both the rods and the switch points by two bolts.

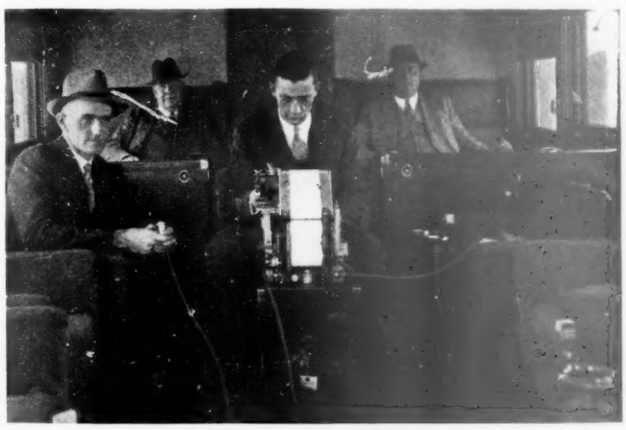
It is claimed that the vertical rods with the clips provided insure greater rigidity and more effective hold-down for the switch points than can be secured with flat type rods, and also that the conical bearing feature of the clips prevents the accumulation of lost motion due to the wear on bolts and rods which cannot be avoided in the standard side jaw clip arrangement. The new No. 0 and No. 1 rods can be furnished either as the plain rod shown, or with their ends twisted outside of stock rails to bring the broad side in a horizontal position at the ends for connecting-rod attachment. These same rods can be furnished with an insulated basket at the center where it is desired to arrange the switch for interlocking.



Elevation of One of the No. 0 Vertical Compensating Rods, Together With Details of the Swivel-Bearing Connecting Clips

Develops Portable Track Recorder

SPERRY PRODUCTS, INC., Brooklyn, N. Y., has developed a portable track recorder, which is designed not alone to provide an accurate graphic record of the location and magnitude of track irregularities under full train load, but which is said to be equally effective for determining the comparative riding qualities of different types of locomotives and cars. The new unit, which is called the Sperry Gyro Track Recorder, Portable Type, records directly car tilt or roll, car bounce, nosing and lurch, and through these factors, indirectly, the condition of track cross level, alinement, gage and surface.



Recording Track Conditions at 50 Miles an Hour, Within the Observation Compartment of a Business Car

The fundamental mechanism within the recorder is a specially designed Sperry gyroscope, which maintains a stabilized vertical plane relative to the earth independent of car or track level and undisturbed by acceleration or centrifugal forces. Through this mechanism, angular displacement of the car body, either vertically or horizontally from the fixed plane of the gyroscope, caused by irregularities in cross level, super-elevation, wide gage or poor track alinement is indicated on the record. Other elements in the unit include a specially designed pendulum system, which permits the recording of lateral lurch of the car, the result of misalinement on curves or tangents, and a dampened inertiaweight system, which causes the registering of car bounce, produced by irregularities in longitudinal track surface.

The record produced by the machine is made by a group of pens on a moving paper tape, 3⅝ in. wide, the movement of which is directly proportional to the distance traveled over the track, equaling approximately 13 in. to the mile. Five independent graphic records

are produced, as shown in the accompanying reproduction of a typical section of the tape, Fig. 1, made while operating the machine over generally well maintained track in a business car. Line No. 1 of the record shows sidewise lurch of the car body, as reflected by poor alinement on either curved or tangent track. Line No. 2 shows car bounce, reflected by appreciable irregularities in track surface. Line No. 3, with its accompanying base line, registers car tilt or rock, reflected by irregularities in the cross level of the track or super-elevation of one of the rails on curves. This record is approximately to scale, ⅛ in. lateral displacement of the record line equaling 1 deg. of car tilt or 1 in. difference in elevation of the track rails.

Line No. 4 gives indications of car nosing produced by misalinement on tangents or wide gage, or a combination of these. This line also defines the beginning and end of curves. Line No. 5, in which offsets can be produced by the operation of a push button in the hands of an observer, is a landmark line. Another record on this line is an automatic 60-sec. interval marker, from which, after having determined the actual scale of the record, the speed of train operation over any section of the track can be determined.

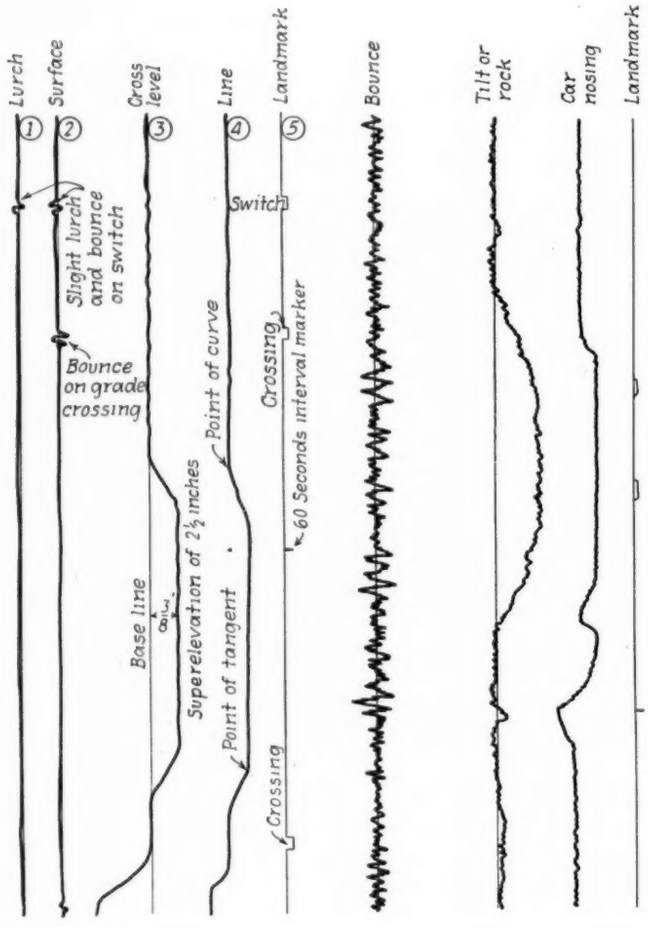


Fig. 1—Section of Record Tape Produced While Operating the Machine Over Generally Well-Maintained Track, in a Business Car

Fig. 2—Section of Record Produced by the Machine While Moving Over Fairly Well-Maintained Track in a Loaded Milk Car

Fig. 2 is a section of record produced by the machine when moved over fairly well maintained track in a loaded milk car with standard A.A.R. trucks. From this section of record, in which the sidewise lurch line is omitted, it is obvious that the car tested was subject to continuous bounce and side sway.

When recording track conditions, the recorder is preferably set up in a passenger or business car, directly over the rear trucks. Energy for the operation or control of its electrical mechanisms is taken directly from the car lighting system. However, in order that the record tape movement may be proportional to the length of track covered, it is operated by means of a flexible shaft which is extended out of an adjacent window and attached to the end of one of the truck axles by means of a magnetic chuck. When recording the riding qualities of locomotives or cars, the equipment can be located at any point desired within the locomotive cab or the cars. In the case of freight cars, where a 32-volt power supply is not available, storage batteries are used to operate the recorder, and in the case of certain types of locomotives, an auxiliary motor drive for the tape record is substituted for the axle drive.

Since the record of the machine reflects simultaneously both track conditions and the riding qualities of the equipment in which it is operated, the same unit of equipment should be employed for all testing of track conditions on an individual road to eliminate the equipment factors when comparing the track conditions on different parts of the road or when retesting any specific territory or piece of track. For the same reason, when comparing the riding qualities of cars or locomotives, all test runs should be made over the same piece of track to eliminate the influences of strictly track conditions. In either case, comparative testing should be effected at approximately the same speed, 50 m.p.h. having been found well adapted for track recording, although lower speeds may be used successfully for testing the riding qualities of freight cars and locomotives. As a matter of fact, by testing the same equipment at various speeds over the same piece of track, the best riding speed, or the critical speeds for bounce, side sway or nosing, can be determined.

The record tape produced by the recorder is of such character that it can be blueprinted readily. Thus, copies of it, in whole or in part, can be distributed to those particularly interested for detailed study or for programming immediate or future work. The recorder, accompanied by an operator, is being rented by the Sperry Company on a daily service basis.

Selective Process for Heat Treating Rails

THE Ramapo Ajax Corporation, New York, has developed a selective process for heat-treating rails for use in special trackwork, whereby the head is hardened to resist abrasion and impact from wheel loads, while the thin sections of the web and base are not hardened but are annealed to increase the ductility of these parts so that they will better withstand impact strains. Briefly, the process consists of three steps: Heating the entire rail; quenching the head only; and allowing the rail to cool in a "retarded cooling" pit.

The rails are heated in a specially designed gas-heated furnace, where the temperature is slowly raised to the proper quenching temperature, which varies with the chemical analysis of the rail, and which is maintained for a specified time. The rails are then removed from the furnace, inverted, and suspended with the head sul-

merged in a molten mixture of lead and alloys for a specified minimum time, from which they are then removed and deposited in the retarded cooling pit, where they are allowed to cool slowly to practically room temperature.

The various temperatures embodied in the heat treating and quenching processes are determined by the chemical analysis of the rails being treated, as well as the Brinell hardness number which it is desired to attain. Rails treated by this process are said to show a uniform increase in hardness throughout the head as compared with as-rolled rail, while, by annealing the bases, the ductility of the rails is also said to be increased as compared with that of as-rolled rail.

Printed Weight Records

A DEVICE for attachment to scale lever weighing systems, which gives a printed record of weights, has been developed by Fairbanks, Morse & Co., Chicago. This device, which is known as the Printomatic weigher, is designed for ticket or continuous roll tape weight recording in single, duplicate or triplicate

Scale Equipped With a Fairbanks, Morse Printomatic Machine

copies. It is readily adaptable to numerous types of Fairbanks scale lever systems and operates independently of the normal functioning of the self-indicating dial. Only the correct weight as indicated on the dial is printed by the Printomatic machine.

The outstanding feature of this device is said to be the fact that it can be co-ordinated with other weighing operations at points remote from the point of weight recording. In this manner any number of scales from one to six can be arranged for connection to a single printing unit which may be located at any point conveniently accessible to persons responsible for the handling of weight records. Another feature of this recording device is that designation numbers or letters can be arranged in symbolic form to provide considerable data incident to the weighing operation, such as the identification of an ingredient in a batching process, tare or gross weight, etc. A time recorder giving the year, month, day, hour and minute of operation is available if required.

Flashing-Light Crossing Signal

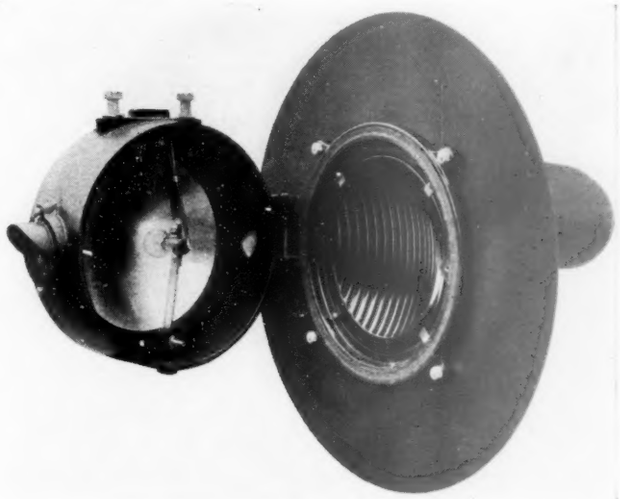
WHEN A. A. R. requisites that highway crossing signals should shine in both directions were accepted, the Union Switch & Signal Company, Swissvale, Pa., introduced its HC-8 crossing signal, with backlight, to meet the situation by the use of one lamp bulb and a 5⅜-in. diameter backlight. For those cases, however, where a backlight indication of the same intensity and spread as the front indication is desired, this company has recently introduced a new design, designated the "Union" HC-81 flashing-light highway crossing signal.

The new signal has a shallow, parabolic glass reflector eight inches in diameter. This reflector, with all the inherent advantages in efficiency of a silvered glass reflector, has its silvered backing protected in an entirely new manner. In this process, the back of the glass reflector is first silvered; then the silver surface is plated with a heavy coating of copper and this, in turn, is protected by baked enamel. The backing is then sealed in a metal cover which excludes all fumes and moisture which might tend to deteriorate the silvered surface.

The reflector, by reason of its size, provides a beam for the full exposed diameter of the cover glass. This glass is the same as used on the Style HC-8 signal and provides a 30-deg. spread, 15 deg. on each side of the axis.

The new HC-81 crossing signal includes several other improvements not incorporated in previous models. The signal case is provided at the bottom with a small ventilator which is filled with lamb's wool. This ventilator permits air to enter the signal but filters out any dirt or dust particles in the air. It also allows moisture that might condense inside the signal case, to drain out.

The socket assembly used is of an improved design. The reflector is mounted onto a heavy sheet-metal ring, on opposite sides of which are two moulded bakelite ter-



Union Type-HC-81 Flashing Signal Unit

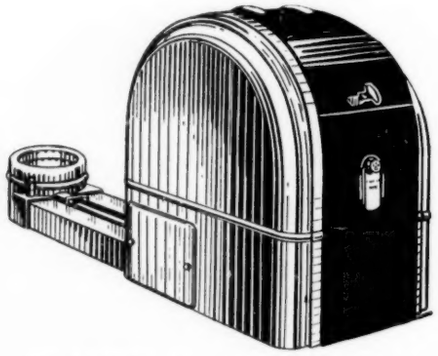
minal blocks. These terminal blocks are bridged by a pressed metal socket support. This method of mounting provides the best of insulation and the bridge construction of the socket support is considerably stiffer than the cantilever casting construction used on previous designs. Because of the increased size of the reflector, a high beam candlepower is obtained.

Lamp bulbs are S-11 type, single-contact, bayonet candelabra base with 1¼ in. light center length. Various ratings are available for the different voltages in common use, the wattage being from 10 to 18. Either single-filament or double-filament lamps may be used. The double-filament lamps are provided with a secondary filament of extremely long rated life that remains lighted after main filament burns out. All of the lamp bulbs for this service are based accurately to 1/64-in. precision, known as "signal precision." The receptacles in the signals are accurately located optically to secure maximum efficiency. This efficiency is maintained when the "signal precision" lamp bulbs are used for renewals, without the need for any additional adjustment.

Under-Feed Stoker

AN automatic stoker designed for use in railroad stations, offices, freight houses, etc., is now being marketed by Fairbanks, Morse & Co., Chicago. This stoker, which is of the single retort, under-feed, continuous transmission type, is available in capacities to meet various heating requirements. In this stoker the coal is forced into the fire box from beneath by a screw feed which operates continuously at a rate depending on the immediate heating requirements as determined by a thermostatic control. This method of feeding the coal into the fire box is said to assure that the maximum heating value of the coal will be obtained and that the amount of ash is reduced to a minimum. To assure an adequate quantity of air for proper combustion, a forced draft is provided which supplies air through tuyeres in the retort in the proper amount for the quantity of coal being fired.

The hopper and the fan, together with the motor for operating the screw feed and the fan, are contained in a welded steel housing which has a hinged opening in its curved top, through which the hopper is charged. The fan is of the centrifugal type and operates at a constant



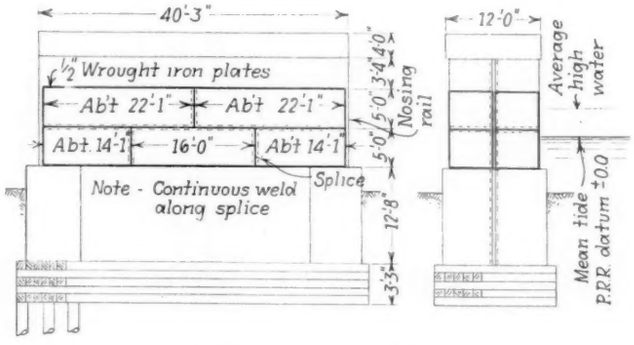
The Fairbanks, Morse Under-Feed Stoker

speed, the output of air being regulated in accordance with the requirements of the fire by the automatic adjustment of a shutter. Air from the fan is conveyed to the fire box through welded steel duct. As a safety precaution this stoker will automatically stop operation and sound an alarm in case of trouble, such as the depletion of the water in the boiler.

Other features of this stoker include pressed and welded steel construction for most of the essential parts, copper-bearing steel being used extensively; the provision of a spike-catcher in the hopper base which prevents bolts, spikes and similar objects from entering the coal conveyor tube; and a conveyor screw comprising a heavy alloy steel casting, which is specially designed to minimize power requirements.

Wrought Iron Plates for Pier Protection

THE application of an armor of wrought iron plates to that part of a concrete bridge pier within the high-low water range has been adopted in a number of instances as a means of protecting the concrete against the destructive action of ice and other floating objects. Wrought iron plates are used for this purpose because of



Elevation and End View of the Pier Showing the Arrangement of the Wrought Iron Protection Plates

the resistance they offer to the corrosive action resulting from alternate submersion and exposure to the air.

An example of this type of installation is afforded by a project on the Pennsylvania for protecting a pier in the approach to its drawbridge across the Passaic river at Passaic, N. J. In connection with repair work on this pier it was decided to encase the pier in the tide range with wrought iron plates in an effort to protect the concrete against damage and thus obviate future expenditures for repairs. The existing pier was of conventional shape with nosings at both ends, there being a two-direction current because of the tide, and with battered sides which extended in unbroken lines from the coping to the timber-grillage footing. In the repair work a jacket of reinforced concrete was applied to the shaft in such a manner as to give vertical lines to the sides and ends of the pier and to provide a starling. In connection with the application of the new concrete a rail buffer with the head protruding was embedded in each nosing.

In protecting the concrete the shaft of the pier was encased in ½-in. wrought iron plates for a distance of 10 ft. above the top of the starling. Of varying lengths, the plates are 60 in. wide and are fastened together by butt welding and also by wrought iron splice straps which are fillet-welded to the plates on the under side. For anchorage the plates are welded to the ends of ¾-in. round rods, 14 in. long and with a 2-in. bend at

the opposite end, which are embedded in the new concrete shell of the pier. The plates for each side of the pier were formed and fabricated into one piece in advance of their application.

The wrought iron plates for this installation were furnished by the A. M. Byers Company, Pittsburgh, Pa., and were fabricated by the Belmont Iron Works, Philadelphia, Pa.

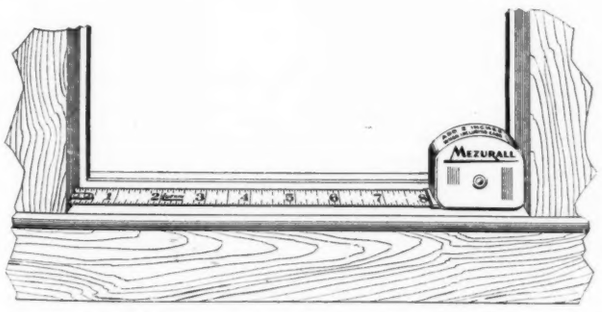
Morrison Introduces New Welding Service

THE Morrison Railway Supply Company, which has conducted a contracting business in the repair of trackwork by arc welding, has arranged to expand its service in this field in the interest of those railroads that carry on such work with their own forces. This service embraces consultation and advice on proposed welding work, inspection service by Morrison experts on frogs and crossings scheduled for repairs, experienced instructors to assist welding operators, the use of the Morrison Metalweld process, and a manual of complete instructions for the reconditioning of manganese track units to be placed in the hands of each operator. For railroads who contract their welding repairs, the Morrison Company has established territorial licensees at strategic points who will take contracts on work located within a radius of 100 miles of their headquarters.

The function of the new consulting and instruction service, as pointed out by representatives of this company, is to enable railroads to gain the benefit of experience extending over a period longer than that enjoyed by any members of their own forces. Through such means, it is claimed that it will be possible to avoid such causes of defective work as the imparting of heat to the parent metal, inferior quality of the welding rod, faulty preparation (by grinding), improper welding procedure, poor finish-grinding and difficulties encountered due to faulty installation of frogs and crossings.

Lufkin Tape Rule

THE Lufkin Rule Company, Saginaw, Mich., has placed on the market a new 6-ft. tape-rule, known as the Mezurall tape-rule. A feature of this tape is the fact that the case is flat on the bottom and ends so that it will stand unsupported with the blade projected horizontally, or upward or downward. The length of the case is exactly two inches so that measurement may be made from the back end of the case by adding two inches to the figure indicated on the tape where it emerges from the other end of the case. Thus, in taking inside measurements the back of the base is butted against one side of the opening to be measured and the blade is extended to the other side.

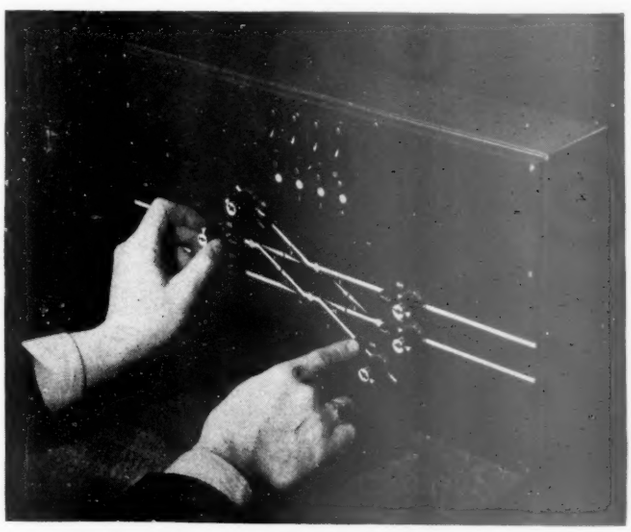


Demonstrating the Method of Making Inside Measurements with the Mezurall Tape-Rule

The end of this tape-rule is provided with a hook having short sliding action, which is said to adjust itself automatically to give accurate results when hooked over any object or when the end of the blade is projected against a surface. The blade is stiffened by concave forming and can be projected unsupported in any direction. It can also be flexed to measure circles and odd shapes. The case is $9/16$ in. thick, has rounded corners and is nickel plated.

Type-NX Interlocking

THE General Railway Signal Company has announced the development of its Type-NX interlocking system, which is expected materially to influence the design of future installations. The basic principle of the system hinges on the fact that trains through an interlocking plant travel by routes which have an entrance and an exit. The operator needs to know only these two details about a train's movement, and he directs it accordingly.



Routes Are Set Up By Turning the "Entrance Knob" and Pushing the "Exit Button" of the "NX" Interlocking

Knowing where the train is entering, the operator turns the "entrance knob." Knowing where the train is going, he pushes the "exit button." The rest is automatic. The switches line up, the signal clears, and indicators on the control board indicate the positions and the locking of the switches, the clearing of the signal, and the occupancy of the various track sections in the route, as the train proceeds through the plant. The switch-point indicators on the control board clearly define the route set up.

Because of the absence of switch and signal levers, the NX-type electric interlocking allows the operator to concentrate on the directing of trains and relieves him of the responsibility of operating switches and signals. He directs trains in every sense of the word, thinking

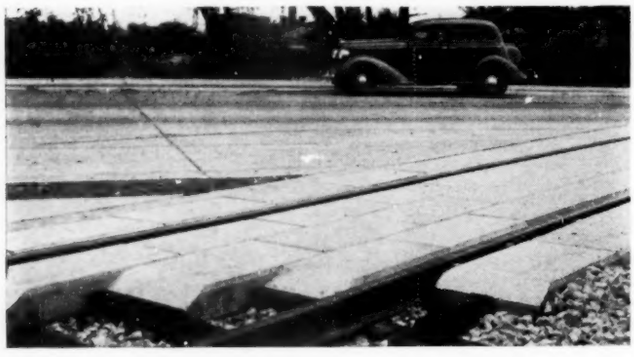
no more in terms of separate functions but of routes. His sole interest is to get the train "in here" and "out there."

The most important claim made for this new type of electric interlocking is the fact that extreme simplicity of operation and the elimination of lever manipulation give speedier operation with reduced chances for errors. Secondary routes are selected automatically in case a principal route is obstructed by a train or for other reasons. Continuous indications are provided for all routes and operating functions, and these are directly associated with the control panel rather than with a separate piece of apparatus.

View Illustrating the Manner of Installing the Concrete Crossing Slabs

New Concrete Slab Highway Crossing

A NEW design of reinforced concrete slab railway-highway grade crossing embracing several innovations in design was installed recently by the Chicago, Milwaukee, St. Paul & Pacific where two of its tracks cross Port Washington road in Milwaukee, Wis. The precast slabs employed in this installation were manufactured by the Blue Jay Cast Stone Company,



The Completed Crossing

Madison, Wis., in accordance with specifications drawn up jointly by the railroad and the Wisconsin State Highway Commission.

These slabs are rectangular in area and are 3 ft. 3⅞ in. long. They are installed in five longitudinal lines, one outside the rails on each side of the track and three between the rails. The thickness of the slabs varies with the height of the rail with which they are used and is such that when installed, the surface of the crossing is ½ in. below the top of the rails. Constructed of 8,000-lb. concrete, the slabs are each reinforced with four ½-in. round bars placed near the bottom. A non-skid wearing surface is provided.

Used with a tie spacing of 20 in. center to center, each slab is so installed that it extends between the midpoints of alternate ties, the joints in adjacent rows of slabs being staggered. To prevent longitudinal movement of the slabs, each one is recessed or dapped on the under side to receive the ties, the recess at the center being of such depth as to afford a clearance of ½ in. between the top of the intermediate tie and the under surface of the slab. Thus, the slab is supported entirely at the ends and the possibility of its "teetering" on the intermediate tie is obviated. In addition to the daps in the slabs, the only other anchorage or fastening of the crossing consists of creosoted oak blocks that are spiked to the ties against the end slabs.

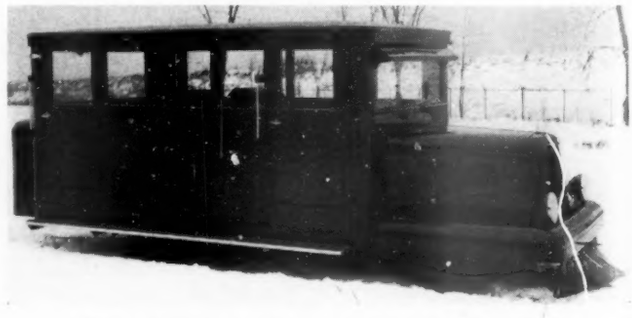
Those slabs that are installed next to the rail fit against the edge of the base of the rail and are provided with recesses for the spikes, tie plates and joint bars. The edges of the slabs next to the gage side of the rail are grooved to provide a flangeway, while elsewhere the edges are beveled so that a V-shaped groove is provided between adjacent slabs. To prevent damage to the crossing due to dragging equipment, etc., the ends of the end slabs are heavily beveled.

In the installation of this type of crossing, it is specified that particular care be taken to provide a firm, well-drained foundation. For the crossing on the Milwaukee, 24 in. of crushed stone ballast was placed beneath the ties, and drained by a 6-in. perforated pipe under each track. To prevent possible displacement of the slabs through settlement of the track or the heaving of the ballast, the cribs were filled only to within 2½ in. of the tops of the ties. In the construction of this crossing new sawed ties, rails, tie plates (fully spiked) and fastenings were installed.

Advantages claimed for this type of crossing are a low maintenance cost, ease of installation, and the fact that the slabs can be handled readily by two men, enabling them to be removed readily if maintenance work at the crossing should become necessary.

Official Inspection Car

A NEW official inspection car, designated as Model 65, has been brought out by the Kalamazoo Railway Supply Company, Kalamazoo, Mich. This car, which is powered with a 1936 Ford V-8 engine, seats nine persons, an aisle being provided between the seats so that passengers may transfer from one seat to another without opening the doors. The rear seats are of the



The Kalamazoo Model 65 Official Inspection Car

reversible type and a collapsible table is provided at the rear end of the car. Ample space for the storage of hand bags is provided by a trunk which is mounted on the rear of the car. To assure a clear view of the track from any seat in the car a large windshield is provided at each end. The car is equipped with air brakes and the wheels are of the rubber cushion type. Shatterproof glass is used throughout.

Coded Track Circuit

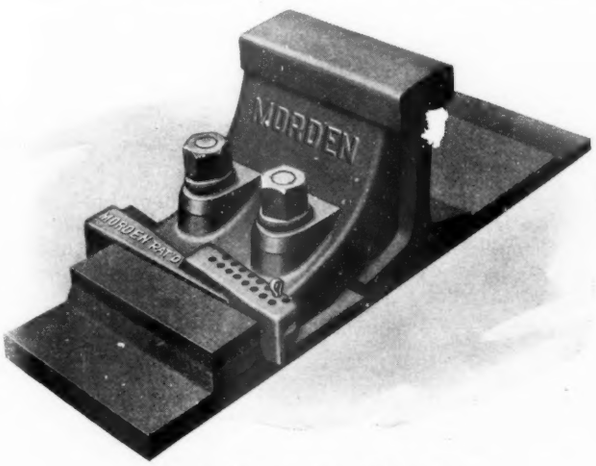
THE General Railway Signal Company has announced the development of a full line of apparatus for the application of coded track circuits to signaling systems. This track circuit differs from the ordinary track circuit in that the supply of energy to the rail is periodically interrupted or "coded."

Several advantages are claimed for this new system. One of the more important features is that the use of "coded" energy in the track circuits provides increased immunity to false energization, thereby increasing the degree of safety. This feature is inherent, for when the track relay is either continuously energized or continuously de-energized, a stop indication is displayed by the signal. Since the system requires continuous movement or operation of the code-responsive apparatus to display "proceed" indications, mechanical failures result in "stop" indications.

The use of the three common train-control "proceed" codes, that is, 75, 120 and 180 code cycles per minute, provides a full complement of signal controls without the use of line wires. It is possible to secure an additional indication to effect a 4-block 5-indication signaling system by merely adding a 240 code. This system may be employed with or without cab signals.

Morden Develops New Rail Brace

A NEW type of adjustable rail brace, known as the Morden security adjustable rail brace, has been developed by the Morden Frog & Crossing Works, Chicago. Employing substantially the same principle embodied in the adjustable brace formerly manufactured by this company, although featuring a number of improvements over the old model, the new brace consists of three principal parts—the brace proper, the brace plate, and the wedge which is inserted between the toe of the brace and the stop on the plate.



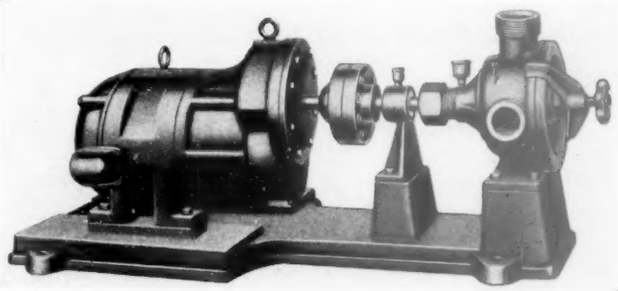
The Morden Security Adjustable Rail Brace

The brace proper, which is formed of malleable iron, presents a curved surface backed by four vertical reinforcing ribs, which bear against the web of the rail on the one hand and the floor and stop on the brace plate on the other. Two heat-treated high-carbon bolts, inserted through slotted holes in the brace, hold the brace to the plate. In order to protect the bolt shank from the corrosive influence of water or brine drippings, the slotted holes are closed with malleable iron cover washers. With no external reinforcing ribs present on the brace it is pointed out that there is no impediment to the free wrenching of the hold-down bolts, using a standard track wrench.

A feature of the wedge, which is also of malleable iron, is that a stainless steel cotter pin is used to lock the wedge to the brace. Thus, as the cotter pin is noncorrosive, it is pointed out that necessary adjustments due to wear are readily made. The holes in the wedge are so spaced as to permit a total adjustment of $\frac{5}{16}$ in., divided into increments of $\frac{3}{100}$ in.; thus it is pointed out that a tight fit is assured at all times.

Fairbanks, Morse Pumping Equipment

FAIRBANKS, MORSE & CO., Chicago, has made two developments in pumping equipment, including a line of rotary pumps, known as Fig. 5130 perfection rotary pumps, and a series of motor-pump units, designated as Fig. 5550 built-together motor-pump units. The perfection rotary pumps, which are available in capacities ranging from $1\frac{1}{3}$ to 225 g.p.m., may be used for pumping brines, creosote, fuel oil, gasoline, paints or, it is said, any liquid that will flow through a pipe. These pumps are said to retain all the characteristics of



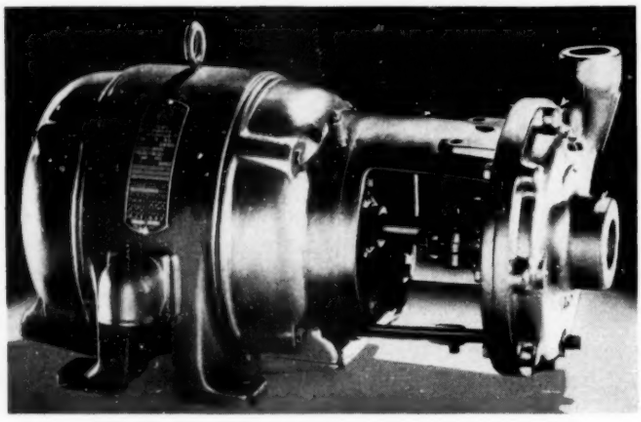
View of a Fairbanks, Morse Fig. 5130 Perfection Rotary Pump

the internal gear type and, in addition, have helical cut rotor and pinion gears.

The use of helical gears in these pumps is said to have the advantage that whenever the column of fluid is severed in the pump, which happens each time that one of the internal gears passes by the intake or discharge ports, the cutting is done by a shearing action, thus eliminating shocks and vibration in the pump. It is also pointed out that the end thrust produced by the helical gears in the pump is applied to advantage in taking up the wear and also assures a close fit between the pump

head and gears, resulting in the maximum suction capacity. These pumps are available with a range of drives, the motor in most cases being mounted on the same base with the pump.

The Fig. 5550 built-together motor-pump unit consists of a centrifugal pump, with an enclosed bronze

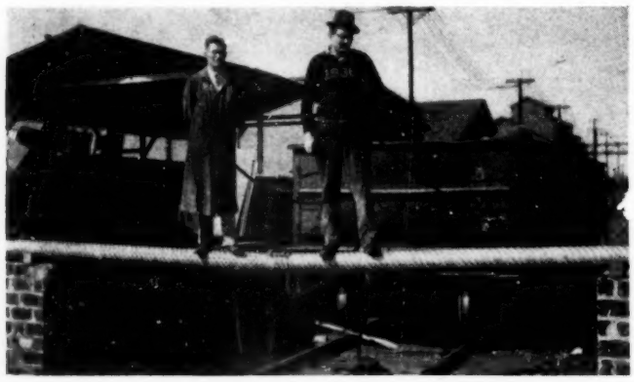


One of the Fig. 5550 Built-Together Motor-Pump Units

impeller, mounted directly on the shaft of a Fairbanks, Morse splash-proof motor. These units are available in capacities ranging from 10 to 250 g.p.m., and will pump against heads as great as 190 ft. The motor sizes range from ¾ hp. to 10 hp. In each of these units the rotor and exhaust fan of the motor and the pump impeller are mounted on a one-piece steel shaft which is carried on two SKF ball bearings. To assure rigidity and the proper alinement between the motor and the pump, the latter is connected with the motor end-bell by a one-piece connection which is formed integral with the backhead of the volute and the stuffing box. The discharge opening of these pumps may be placed in any one of eight positions.

Armco Corrugated Pipe for Drainage

THE Armco Culvert Manufacturers Association, Middletown, Ohio, has developed a new type of perforated pipe, known as Hel-Cor perforated pipe, which is specially designed for subgrade drainage. An unusual feature of this pipe is the form of the corrugations which run helically or spirally around the pipe instead of circumferentially as in the usual manner. Another feature embodies the use of lock seams instead of riveting as the method of fabrication.



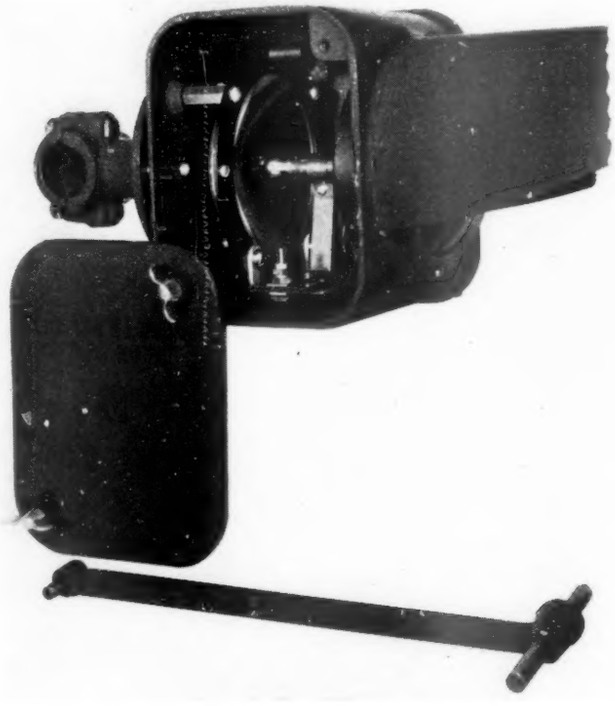
Illustrating the Supporting Strength of Hel-Cor Perforated Pipe

Because of these features the pipe is said to be economical and yet to sacrifice none of the qualities of strength, durability and infiltration capacity of the standard perforated pipe. It is furnished in 6-in. and 8-in. diameters and may be galvanized, bituminous coated, or bituminous coated and paved.

Position-Light Signal

A NEW position-light signal, embodying several improvements over previous designs from mechanical, optical and economic standpoints, has been introduced by the Union Switch & Signal Company, Swissvale, Pa., and is designated the Style PL-2.

For simplicity of description, the new signal is compared with the previous Union position-light signal. An



Union Style-PL-2 Position-Light Signal

optical comparison of the two units discloses that the new signal, with an 8-volt 5-watt lamp, has higher beam candlepower than the previous signal with a 12-volt, 9.5-watt lamp. This greater beam candlepower is obtained not only on the axis, but also at all angles below and to each side of the axis.

While the previous style signal had no sighting device and required two or more men at least two hours to aline properly in the field, each unit of the new signal may be alined by means of a sighting tube, which permits one man to adjust properly all units of one signal within a half hour.

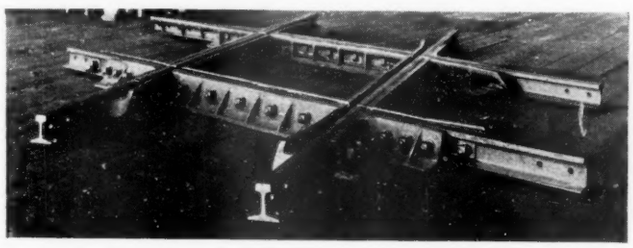
All fittings for attachment to the spider arm remain unchanged so that previous units can be replaced. The new signal unit includes a terminal box and hub casting with a bakelite terminal board having terminal posts moulded in. A new specially developed convex spread-light cover glass in Noviol yellow, with the top inclined

forward 15 deg. to eliminate surface reflection, together with a spheritoric mirror unit, replaces the former inverted lens and conical cover glass.

Lamps used in the PL-2 signal, because of their increased optical efficiency, are of reduced wattage. Consequently the power requirement is lower by approximately one half than that of previous models. Notwithstanding this reduced wattage, the beam candlepower is considerably greater. The spread-light cover glass of the new unit provides at least twice the horizontal beam spread of the previous signal and thus provides better indication for curved track.

A Permanent Base Railroad Crossing

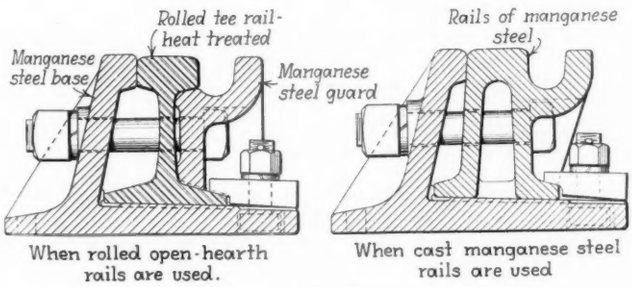
A NEW type of railroad crossing has been placed on the market by the Pettibone-Mulliken Company, Chicago. As indicated by the name, Asselin Permanent Base crossing, the construction embodies the use of a base or frame of alloy manganese



A Permanent Base Crossing With Rolled Steel Running Rails

steel that serves as the support for the running rails, which may be of cast manganese steel, ordinary open-hearth rolled rails or heat-treated open-hearth rails.

The base members are L-shaped, the vertical leg being heavily reinforced by ribs and provided with bolt holes through which the running rails are bolted to them. If



Typical Cross Sections of the Permanent Base Crossing

cast manganese running rails are used, these are of a section with a double web and a built-in flangeway. The use of rolled section running rails requires provision for a cast guard-rail member. These two types of construction are illustrated in the typical cross sections. As the base section is the same whether rolled or cast running rails are used, it is possible to substitute one type of running rail for another whenever the running rails are renewed.

The object of the "permanent base" construction is to permit the renewal of any or all running rails as they become worn. This makes it possible to maintain the crossing to a high standard at a fraction of the cost that would be incurred in its complete renewal. The base can be made canted to meet the connecting rails of canted track and it can be provided with rubber pads to reduce noise and wear.

Inland Introduces New High-Strength Steel

THE Inland Steel Company has introduced a new steel, Hi-Steel, in the so-called low-alloy, high tensile strength class. This steel has a minimum yield point of 60,000 lb. per sq. in. for gages lighter than ¼ in., and 55,000 lb. for heavier gages. Its ultimate strength is 70,000 lb. per sq. in. or more, the elongation in 8 in. is 20 per cent or greater and the reduction in area is 55 per cent or more. In gages lighter than ⅛ in., the steel will bend flat on itself in both directions, while in heavier gages it will bend 180 deg. around a pin having a diameter equal to the thickness of the metal. It can be rolled successfully into sheet, strip, plate and structural sections, while tests extending over a year's time show that it will bend, form, stamp, seam and weld readily. While corrosive data are not complete, it is reported that the results of laboratory tests and of outdoor corrosion tests extending for six months indicate good resistance to corrosion. It is also said that the resistance of the steel to atmospheric exposure should be appreciably higher than that of copper-bearing steel.

A Zeolite-Compound Treatment for Boiler Water

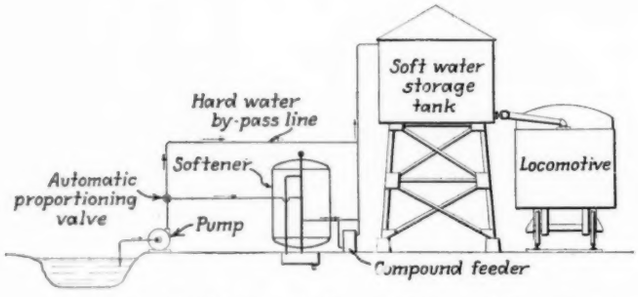
THE Permutit Company, New York, has extended its service to the railroads to include the furnishing of chemicals for treating locomotive feedwater, these chemicals being prepared in liquid, powder or briquet form as required. They are proportioned to the water by the type of Permutit feeding equipment best adapted to local conditions. With this addition to its line, the company is in a position to offer any method of external or internal treatment desired by the railroads or a combination of such methods.

A particular point made by the Permutit Company in this connection is the opportunity afforded to use a combination of the zeolite and compound treatments, which is explained by the following comparison of the procedures in the conventional compound treatment and the combination zeolite compound treatment.

The usual compound practice is to (a) include sufficient alkaline material to raise the alkalinity of the feedwater above the hardness by a predetermined amount and (b) supplement the alkali content of the compound with coagulants and retarding agents to prevent clogging of branch piping, etc. By such treatment, incrustants are changed to soft sludge-forming matter removable through the blowoff cock.

The combination zeolite and compound treatment (a) softens the water partially by zeolite, lowering the hardness to the desired extent below the natural alkalinity of

the water, and (b) coagulants and retarding agents are then added separately and are small in amount compared to the chemicals needed for straight compound treatment. According to representatives of the Permutit Company, this combination method of treatment is said to provide at low cost the desired alkalinity conditions without undesirable excess, and through the partial reduction in hardness it reduces the volume of sludge-forming solids, so that there is less sludge to remove in the blowoff.



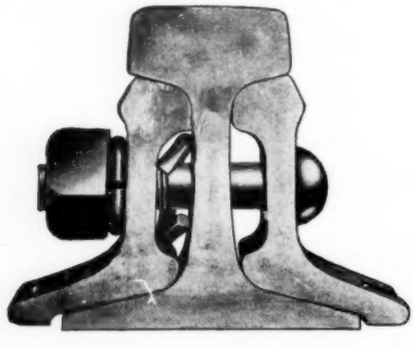
Layout for a Combination Zeolite and Compound Treatment

The manufacturer also provides completely automatic zeolite and proportioning equipment, thus reducing the labor and attention required to a minimum.

A Spring Washer Rail Bond

A RAIL bond involving the use of spring washers between the webs of the rails and the joint bars is being introduced by the Reliance Spring Washer division of the Eaton Manufacturing Company, Massillon, Ohio, after a series of extensive service tests. It is known as the Hy-Crome bonding spring washer.

As shown in the cross section of a rail joint assembly, the washers are applied to the two inside track bolts between the rail and the joint bar. However, unlike most spring washers for use on track bolts, these washers are given an added bend on each end so that the edges will have a tendency to cut into the adjacent rail and joint bar surfaces and thus insure a bright metal contact for an effective electrical connection. Furthermore, the pitch of the helical twist given to the washer is so proportioned for the particular joints on which it is to be used that the washer will have the proper reactive values to insure contacts under all variations in the fit of the bars on the rails. The washers are also cadium plated to resist corrosion.



Joint Assembly with the Hy-Crome Bonding Spring Washer in Place

Among the advantages claimed for this type of bond are that it does not interfere with track work; is protected against injury from track tools or dragging equipment; is easily installed, without special equipment; is not affected by rail-end welding; and provides a track circuit that will protect traffic in the event of a rail break in the joint.

New Highway-Railway Maintenance of Way Car

THE Evans Products Company, Detroit, Mich., developers of various models of combination highway-railway buses, has adapted its auto rail-mounting equipment to various stock or special models of highway motor trucks in order that such trucks may be used by the maintenance of way department forces in the handling of men and materials directly to and from the site of work on the track. The new units, known as Evans Auto-Railer maintenance of way cars, are designed to operate with equal ease on either the highway or railway track, transferring readily from one to the other at any normally paved grade crossing.

Dump Body Evans Auto-Railer, Designed for General Use by Maintenance of Way Forces

In the new units, the motor truck, with standard wheels and pneumatic tires, is supplemented by four flanged steel wheels, two ahead and two to the rear, in line with the tired wheels. These flanged wheels, which guide the truck when operated on the track, are, both front and rear, arranged on retractable mountings so that when the truck is to be operated over the highway they can be lifted and held clear of the surface of the pavement. When the truck is to be moved over the track, it is lined up on the rails at a road crossing and the flange wheels are then lowered to their guiding position for the rubber-tired wheels. The latter wheels carry the entire load of the truck on the rails, the flanged wheels acting only as guides, except that these wheels are capable of carrying the load and automatically take it up in the event that one of the regular wheel tires becomes punctured or deflated for any reason. Service tests of the equipment on both the track and the highway are said to have demonstrated it entirely practicable, and a substantial means of economy in

transporting men, equipment and materials between gang headquarters, or the stores department, and the specific points on the track where work is to be done.

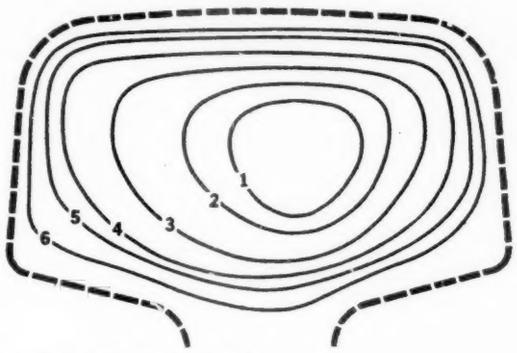
Sperry "Fissurometer" Gives Area of Fissure

THE size of a transverse fissure in a broken rail, expressed as a percentage of the total sectional area of the rail head, may be readily determined with the aid of a device, known as the Fissurometer, which is being distributed without charge by the Sperry Rail Service, Brooklyn, N. Y. This device consists of a rectangular piece of transparent celluloid, 3¼ in. by 5 in., on which is indicated, in a heavy dotted line, the outline of a rail head. Within the rail head, which is reproduced herewith to actual size, are six numbered outlines in solid lines, which represent various sizes of fissures. Above the rail head on the piece of celluloid is a table in which the area within each outline is expressed as a percentage of the sectional area of the heads of various weights of rail. The table is shown herewith.

Size of Fissure (Percentage of Total Sectional Area of Railroad)

Outline number	85 to 90 lb. rail	100 to 112 lb. rail	127 to 136 lb. rail
1	10	9	8
2	20	18	15
3	40	35	30
4	60	53	45
5	75	67	56
6	90	78	68

To estimate the area of a transverse fissure, the Fissurometer is placed against the fissure and is moved until it is determined which of the numbered outlines most nearly matches the outline of the fissure. The size of the fissure is then determined by referring to the proper column in the table opposite the number of the outline.



Reproduction to Actual Size of the Rail Head Shown on the Fissurometer

THE FEDERAL DISTRICT COURT at St. Louis, on February 25, approved the sale by the Wabash of the Rialto grain elevator, Chicago, to General Mills, Inc., for $700,000 cash. The warehouse has been operated for several years under lease by Washburn Crosby Co., Inc., a General Mills subsidiary. The sale was approved on the application of the receivers, who estimated that repairs and improvements on the property costing $500,000 will be necessary in the next five years.

Freight Car Loading

(*Continued from page 428*)

ary 31. The total included 123,420 box cars, 25,286 coal cars, 27,093 stock cars, and 9,198 refrigerator cars.

Car Loading in Canada

Car loadings in Canada for the week ended February 29 totaled 45,263, as against 44,034 cars for the corresponding week last year and 43,566 cars for the previous week, according to the compilation of the Dominion Bureau of Statistics.

	Total Cars Loaded	Total Cars Rec'd from Connections
Total for Canada:		
February 29, 1936	45,263	24,730
February 22, 1936	43,566	22,187
February 15, 1936	43,256	22,727
March 2, 1935	44,034	23,555
Cumulative Totals for Canada:		
February 29, 1936	366,917	199,598
March 2, 1935	383,151	200,426
March 3, 1934	361,860	196,411

N.R.A.A. Presents Excellent Exhibit

(*Continued from page 468*)

elected directors for three years; and R. B. Fisher, manager railway sales, Buda Company, Harvey, Ill., and T. E. Rodman, general manager and treasurer, Maintenance Equipment Company, Chicago, were elected directors for one year to fill vacancies caused by the elevation of Mr. Cowlin to the vice-presidency and the resignation of Mr. McDonald.

Mr. White was born at Mansfield, Ohio, on March 17, 1888, and has, throughout his business career, been connected with the Industrial Brownhoist Corporation and its predecessor, the Brownhoisting Machinery Company, Bay City, Mich. He first became connected with the company in 1907 in a junior capacity in the accounting department, and in 1910 he was transferred to the traffic department as assistant traffic manager, with headquarters at Cleveland, Ohio. In 1917 he was again transferred to the sales department at Chicago, where he devoted the major part of his time to the railway field. In 1921 Mr. White was appointed manager of the company's southern office at New Orleans, La., with territory covering all of the Gulf states, and in 1927 he was returned to Chicago as district sales manager, the position which he holds at the present time. Mr. White has served as a director of the N.R.A.A. for two years, having been elected to that position in 1933. In 1935, adding to his duties as vice-president of the association, he, in the fall of the year, took over the duties of secretary and director of exhibits.

A RAILROAD TAX COMMISSIONERS' ASSOCIATION, known as the Western Association of Railway Tax Commissioners, has been organized in Chicago, the membership embracing tax officers representing all railroads in the territory and the purpose being to exchange views on the constantly changing tax situation. The officers include: President, Harry Miller, tax commissioner of the Chicago & North Western; vice-president, J. J. Tunell, commissioner of taxes of the Atchison, Topeka & Santa Fe; secretary-treasurer, K. W. Fischer, land and tax commissioner of the Chicago, Burlington & Quincy.

NEWS

Canada Trade Pact Seen Booming Railway Traffic

M. P. gives figures showing brisk international trade boosts railway revenues

During the lengthy debate in the House of Commons at Ottawa, still in progress, on the trade treaty between Canada and the United States and which, though it became actually operative on January 1 last, has yet to go through the formality of approval by Parliament, Conservative members said that, amongst other things, this pact would injure the Canadian railways, as it would develop north and south business to the injury of east and west movement within the country.

Robert J. Deachman, an Ontario Liberal, cited to the House figures to show that at periods when there were the highest imports into Canada the railways enjoyed the heaviest traffic, and he contended that under the trade treaty with the United States any increase in imports from that country, as well as increased exports to the United States, would inevitably be of considerable advantage to the Canadian railways. On this subject he said:

"In 1928-29 we had heavy imports from the United States. What was the condition of our railways at that time? They were very prosperous; they were at the highest level of employment and the highest level of earnings in their history, barring possibly the war years. So I worked out a table giving the revenue of the railways, the index of that revenue, and the index of imports from the United States. Taking the basis of 1926 as 100 I find this in seven years, covering 1922, 1926, 1928, 1929, 1930, 1933, and 1934, the three highest years of railway revenue were the three years of the highest imports from the United States; the three lowest years of railway revenue were years of the lowest imports from the United States. I find that when the Conservative government came into power, pledged as it was to cut down imports from the United States, it brought them down, and brought them down with a crash, but it brought the index of railway earnings down from 114 in 1928—as compared with 100 in 1926—to 54 in 1933. With the permission of the house I will place this table upon Hansard:

Calendar years	Revenue of railways	Index of railway earnings	Imports from United States	Index of imports from United States
1922	$440	89	$510	76
1926	493	100	669	100
1928	563	114	826	123
1929	534	108	894	133
1930	454	92	654	97
1933	270	54	217	32
1934	300	60	294	43

Figures of imports and railway earnings in millions—add 6 ciphers.

"The facts point out that the larger our imports from the United States the more prosperous our railways were. The solution of our railway problem, the solution of our traffic problem, does not lie in the restriction of imports from the United States. There is no escaping the obvious fact that every time in Canadian history we have restricted imports its direct reflex has been loss of traffic to the railways. I made that remark the other day to a friend of mine upon the Liberal side of the house—and he said, 'What do you expect? Is not that the natural and logical result to follow?' Not only natural and logical, but inevitable. And when this trade develops, as it will under this agreement, there is no question as to the results so far as the railways of Canada are concerned: they will move back once more to the era of prosperity."

T. V. A. Petition Would Force Southern to Abandon Branch

The Tennessee Valley Authority has filed with the Interstate Commerce Commission a petition asking that the Southern be required to apply for a certificate authorizing the abandonment of its 11-mi. Vasper-LaFollette branch in Campbell County, Tenn. A portion of this branch is located in the reservoir areas to be flooded when the gates of Norris Dam are closed, and the T.V.A. alleges that the inaction of the Southern is induced by "an apparent intention to attempt to recover compensation for the flooding of said lines" before obtaining a certificate.

Contending further that the cost of relocating the branch, on which operations are confined to one mixed train week days, would be out of proportion to the resulting benefits, the petition continues to say that T.V.A. has obtained for the Southern an offer of a favorable trackage-rights agreement from the Louisville & Nashville which has tracks in close proximity to the branch involved.

Railway Net for January a Return of 2.52 Per Cent

$35,764,748 as compared with $21,934,645 or 1.54 per cent in January, 1935

The net railway operating income of the Class I railroads in January amounted to $35,764,748, which for that month was at the annual rate of return of 2.52 per cent on their property investment, according to the Bureau of Railway Economics of the Association of American Railroads. In January, 1935, their net railway operating income amounted to $21,934,645, or 1.54 per cent on their property investment.

CLASS I RAILROADS—UNITED STATES
Month of January

	1936	1935	Per cent Increase
Total operating revenues	$299,098,677	$264,196,972	13.2
Total operating expenses	231,778,646	212,402,473	9.1
Taxes	21,529,301	19,857,107	8.4
Net railway operating income	35,764,748	21,934,645	63.1
Operating ratio—per cent	77.49	80.40	...
Rate of return on property investment	2.52	1.54	...

Gross revenues for January amounted to $299,098,677 compared with $264,196,972 in January, 1935, or an increase of 13.2 per cent, while operating expenses totaled $231,778,646 compared with $212,402,473 last year, an increase of 9.1 per cent.

Class I roads in January paid $21,529,301 in taxes, an increase of $1,672,194 or 8.4 per cent above the same month last year.

Thirty-four Class I roads operated at a deficit in January, of which nine were in the Eastern, nine in the Southern and 16 in the Western district.

The January net railway operating income in the Eastern district was $24,729,559, a return of 3.64 per cent. In 1935, their net was $19,982,569 or 2.94 per cent. Gross revenues in the Eastern district in January totaled $155,870,282, an increase of 11.1 per cent above last year, while operating expenses totaled $115,474,312, an increase of 9.4 per cent.

Class I roads in the Southern district in January had a net railway operating income of $4,712,649, a return of 1.94 per cent; in 1935 their net amounted to $2,756,081 or 1.12 per cent. Gross operating revenues in the Southern district in January totaled $39,226,702, an increase of 14.2 per cent above January, 1935, while operating expenses totaled $30,772,070, an increase of 8.7 per cent.

The January net railway operating income in the Western district was $6,322,540, a return of 1.27 per cent; in January, 1935, the same roads had a net railway

Continued on next left-hand page

HIGH CAPACITY GREATER ECONOMY

without Corresponding Increase in Weight

Without exceeding present weight limitations of track and bridges, modern steam motive power is available that is capable of a surprising increase in net ton-miles per mile of track per day.

Such power costs less to maintain and increases net earnings.

LIMA LOCOMOTIVE WORKS, INCORPORATED, LIMA, OHIO

LIMA LOCOMOTIVE WORKS INCORPORATED

operating deficit of $804,005. Gross operating revenues in the Western district totaled $104,001,693, an increase of 16.1 per cent above January, 1935, while operating expenses totaled $85,532,264, an increase of 8.9 per cent.

R.F.C. Railroad Examiner Joins Financing Firm

Hilton Moore, examiner of the Railroad Division of the Reconstruction Finance Corporation, has resigned to join the staff of Morgan Stanley & Co., Inc., 2 Wall street, New York.

Grade Crossing Projects

At the close of the week ended March 7 contracts involving a total of $44,725,471 had been awarded for grade crossing projects under the federal works program, according to figures compiled by the U. S. Bureau of Public Roads. Plans approved up to March 7 involve $80,900,000.

Long-and-Short-Haul Bill

The Pettengill long-and-short-haul bill is expected soon to be brought up for consideration in the House of Representatives under the rule giving it preferential status which was granted last week by the House committee on rules. Under the rule five hours are granted for general debate and the bill will then be open for the offering of amendments on the floor.

Motion to Dismiss Pension Case Denied

The Supreme Court of the District of Columbia on March 5 denied the motion by government attorneys to dismiss the bill of complaint filed by the railroads, attacking the constitutionality of the railroad retirement act and the accompanying tax act. The court granted the motion of employees of the Atlantic Coast Line to intervene in the case.

Correction

The price of the Eighth Edition of the Handbook of Fire Protection, published by the National Fire Protection Association, Boston, Mass., was incorrectly reported in the February 29 issue of *Railway Age*. The correct price is $4.50.

Hearings on Bill to Eliminate Short-Hauling Prohibition

The Senate interstate commerce committee on March 10 began hearings on the bill, recommended by Co-ordinator Eastman, to amend section 15 of the interstate commerce act so as to permit the Interstate Commerce Commission to establish through routes and joint rates, regardless of the short-hauling of any carrier.

The bill has also been recommended by the Interstate Commerce Commission and is being supported by the American Short Line Railroad Association.

Trucks-on-Flat-Cars Tariff Suspended

The Interstate Commerce Commission has suspended for investigation a tariff filed by the Chicago Great Western to provide for the transportation of the trucks of the Keeshin Motor Express Company between Chicago and the Twin Cities at a rate of $42.50 a truck. The tariff is being opposed by ten competing and interested roads: The Chicago & North Western; the Chicago, Burlington & Quincy; the Chicago, Milwaukee, St. Paul & Pacific; the Minneapolis, St. Paul & Sault Ste. Marie; the Illinois Central; the Atchison, Topeka & Santa Fe; the Missouri Pacific; the Wabash; the Great Northern and the Northern Pacific. The plan proposed is the same as that which has been in effect on the Chicago, Rock Island & Pacific, whereby the railroad hauls Keeshin trucks between Chicago and Davenport, Iowa, Rock Island and Moline, Ill., on flat cars. This "ferry service" for truck trailers was originally started at the request of the Keeshin Motor Express Company which offered to use the railroad for the movement of its highway trailers if the rail rate did not exceed the cost of highway operation, namely, 11⅞ cents per trailer per mile. The commission's order suspends the effective date of the proposed tariff from March 10 to October 10.

Relief Workers for M. of W. on Canadian Lines

The Canadian railways will be the first to absorb men who have been housed in the relief camps across the Dominion and which are to be finally closed by July 1 of the present year, according to an announcement in the House of Commons at Ottawa by Minister of Labor Norman Rogers. That part of his statement relating to the railways' share in the liquidation of a costly piece of relief machinery is as follows:

"In seeking ways and means to provide employment the government has recognized the desirability of affording alternative employment suitable to the training and experience of those now in camps. As a result of negotiations with the Canadian National and the Canadian Pacific through the Minister of Railways, arrangements have been made whereby 10,000 men will be employed on deferred maintenance work on the trackage of these companies during the coming summer. This work will be in addition to the usual maintenance work of the railways. It will be undertaken on a co-operative basis, provision for which will be proposed in the emergency supplementary estimates. Men taken from the relief camps by the railroads will be in private employment and on a basis of work and wages. Relief camps will be closed progressively to permit of the transfer of camp strength to employment on the railways et cetera, as soon as weather conditions permit."

Wheeler Not to Press Government Ownership Bill Now

Senator Wheeler of Montana will not urge action at this session of Congress on his bill providing for government ownership of the railroads. The chairman of the Senate interstate commerce committee stated last week that there is no chance of the bill's being passed at the current session and thus no hearings on it will be held at this time.

In addition to the Wheeler bill there are pending in Congress two other government ownership bills which have been introduced in the House of Representatives by Representative Maverick of Texas and by Representative Lundeen of Minnesota. The former is a companion measure to the Wheeler bill and the latter is not essentially different.

Employment Decreased in 1935

The average number of employees of Class I railroads for 1935, excluding switching and terminal companies, was 994,078, according to the compilation issued by the Interstate Commerce Commission on the basis of the 12 monthly counts. This compares with 1,008,995 in 1934 and 970,893 in 1933. Including switching and terminal companies, the average for 1935 was 1,010,661, as compared with 1,025,155 in 1934 and 986,573 in 1933, and the total compensation was $1,671,071,747 as compared with $1,544,219,621 in 1934 and $1,427,293,251 in 1933. These figures represent the number of employees as of the middle of the month. The average number of employees who received some pay during the month decreased from 1,119,678 in 1934 to 1,104,621 in 1935, or 1.34 per cent.

S. P. Extends Pick-Up and Delivery Service

The Southern Pacific, on February 3, extended its overnight pick-up and delivery service for l.c.l. shipments between Portland, Ore., and Klamath Falls. Shipments collected by the Pacific Motor Transport Company in Portland during the day will arrive by rail in Klamath Falls the next morning at 7:40 for early deliveries direct to the store doors of the consignees. This new service supplements an extensive merchandise freight service already in operation from Portland to practically all major points in Oregon, and it provides shippers and receivers of this class of freight with early next day deliveries as far south as Ashland; to Marshfield and points on the Coos Bay branch; and to cities on the west and east sides of the Willamette Valley.

Occupation Tax on Intrastate Business Held Valid

The State of Washington laid upon practically all persons engaged in intrastate business an occupation tax, effective for two years from August 1, 1933. The tax is measured by a percentage of the gross income solely of that business, and purports not to tax the privilege of doing interstate business. The Supreme Court of the United States holds that the statute is not unconstitutional as to the Great Northern and the Northern Pacific on the theory that it is a burden on interstate commerce, that it violates the commerce clause of the Federal Constitution or the due process clause of the Fourteenth Amendment. The court said:

"If it was the tax which caused the unprofitableness of the local business and consequently the desire to discontinue it, the tax would then appear as a direct burden on interstate commerce. But no reason has been suggested why a tax upon the local business should be held void if despite its burden the local business is conducted at a profit; or if, although conducted at an apparent loss, the corporation

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desires to continue it because of benefits present or prospective."

The tax, the court said, is not upon an instrumentality of interstate commerce; it is moderate in amount; and is not a disguised attempt to discriminate against intrastate commerce. It is imposed solely on account of the intrastate business, and it appears that the amount exacted is not increased because of the interstate business done. Although the two branches of the business of the companies are inseparable, the tax is not laid inseparately upon both, and the statute was held not void on that account. Since the tax was not shown to be a direct burden upon the interstate business of the companies, judgments against them were affirmed. (The amount of the occupation tax for the five months to December 31, 1933, was: Great Northern, $12,988.35; Northern Pacific, $36,116.22.) —Great Northern v. State of Washington. Northern Pacific v. State of Washington. Decided March 2, 1936. Opinion by Mr. Justice Brandeis.

Pennsylvania's Winter Record

M. W. Clement, president of the Pennsylvania, in acknowledgment of the efforts of the employees in keeping the railroad in continuous operation throughout the unprecedented winter, has addressed a letter of thanks to every employee. He says:

Splendid work has been done during the present winter, and I wish to take this means of telling officers and employees how much I appreciate what has been accomplished. There is no previous record in this territory of so long a period of repeated snow and sleet storms and successive waves of zero and sub-zero weather. In the month of January alone it cost the Pennsylvania Railroad more than $1,000,000 extra to fight repeated snow and sleet storms and to overcome the effects of sub-zero weather. Our trains have been kept running and passengers and freight have been moved continuously everywhere on our lines. There were some delays, of course, but no suspension of service, and such delays as occurred were moderate, considering the conditions we had to meet. Other agencies of transport, over the highways, in the air and by water, were forced to suspend, and this greatly increased the volume of traffic which the railroads were called upon to handle. This additional business was handled in a prompt and orderly fashion.

I am very proud of this performance, and I want to thank you all for your part in the extraordinary accomplishment.

Marine Night at New York Railroad Club

At the next meeting of the New York Railroad Club, to be held on Friday, March 20, at 7:45 p.m. in the auditorium of the Engineering Societies building, 29 West Thirty-ninth street, New York, J. H. Lofland, general manager, New England Steamship Company, will present a paper on "The Railroads' Marine Operation in New York Harbor."

Heads of the railroad marine departments in New York have collaborated by furnishing information for this paper which will be supplemented by two motion picture films taken especially for the occasion by E. F. Harrison, official photographer of the Reading-Central of New Jersey, from a tug provided by the Pennsylvania. Charles A. Gill, superintendent of motive power and rolling stock, Reading Company-Central of New Jersey, who conceived the idea for such a program, will make the introductory remarks.

At this meeting prizes will be awarded in the competition for the best New York Railroad Club song.

Equipment and Supplies

LOCOMOTIVES

THE NEW YORK CENTRAL is inquiring for seven Diesel-electric locomotives.

THE LOUISIANA & ARKANSAS is inquiring for five locomotives of the 2-8-2 type.

THE NORTHERN PACIFIC, reported in the *Railway Age* of February 22 as inquiring for 12 Mallet 4-6-6-4 type locomotives, has ordered this equipment from the American Locomotive Company.

FREIGHT CARS

PACIFIC FRUIT EXPRESS.—This company has revised its inquiry and is now calling for bids on 3,000 refrigerator cars and alternate bids on 3,000 underframes.

THE GREAT NORTHERN has ordered 500 ore cars from the American Car & Foundry Company. Inquiry for this equipment was reported in the *Railway Age* of February 22.

THE CHESAPEAKE & OHIO will repair 1,700 steel hopper cars of 70-tons' capacity this year at its Russell, Ky., shops. This work will require about 7,000 tons of steel which will be furnished by the car builders.

IRON AND STEEL

THE DENVER & RIO GRANDE WESTERN has ordered 600 tons of structural steel for six bridges from the American Bridge Company.

THE CHICAGO & NORTH WESTERN has ordered 365 tons of structural steel for bridge work at Kenosha, Wis., from the Bethlehem Steel Corporation.

THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC has ordered 28,000 tons of rails, placing 7,000 tons with the Inland Steel Company and 21,000 tons with the Carnegie-Illinois Steel Company.

PENNSYLVANIA.—A contract has been given to the American Bridge Company for 250 tons of structural steel to be used on an underpass at Franklinville, N. Y. The Rust Engineering Corporation, Pittsburgh, Pa., is the contractor.

MISCELLANEOUS

Air Conditioning

Orders for air-conditioning equipment placed with the Pullman-Standard Car Manufacturing Company are: Northern Pacific, eight mechanical sets, to be installed in company shops; Minneapolis, St. Paul & Sault Ste. Marie, Pullman mechanical units for four solarium cars and Waukesha Motor Company mechanical units for three diners, all installation to be done in Pullman shops; Chesapeake & Ohio, mechanical units and installation for six coaches; New York, Chicago & St. Louis, mechanical units and installation for two coaches

Supply Trade

The International Nickel Company, Inc., New York, has established field representatives at Chicago and Los Angeles, Cal. **H. L. Geiger** is located at 333 North Michigan Avenue building, Chicago, and **A. G. Zima** in the Petroleum Securities building, Los Angeles.

George P. Schumacker, formerly associated with the Worthington Pump & Machinery Corporation, has established an office at 1120 Chester avenue, Cleveland, Ohio, where he will represent the Cooling Tower Company, Inc., the Pennsylvania Pump & Compressor Company, the Quincy Compressor Company, the National Steam Pump Company, the Stets Company, the V. D. Anderson Company, the Williams Valve Company, the Sea-Ro Packing Company and the Mabbs Hydraulic Packing Company.

E. C. Argust, assistant to the president of the **Morden Frog & Crossing Works,** Chicago, has been elected vice-president and secretary, to succeed **J. F. Karcher,** deceased. After graduating from the St. Louis Manual Training

E. C. Argust

School, Mr. Argust entered the employ of the Elliott Frog & Switch Company, East St. Louis, Ill., as a draftsman on April 1, 1903. On September 6, 1906, he resigned to assist in the organization of the St. Louis Frog & Switch Company, St. Louis, Mo., and after serving in various capacities was advanced to secretary. After the liquidation of this company in 1932, he entered the employ of the Morden Frog & Crossing Works as assistant to the president, which position he has held until his recent election.

OBITUARY

Joseph P. McNally, sales engineer for the past several years for the Iron & Steel Products, Inc., Chicago, died on February 29 at his home in Chicago. He was 68 years of age.

J. E. Forsythe, inventor of the Forsythe draft gear and other devices for cars died on March 7 at Chicago.

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Financial

ALABAMA CENTRAL.—*Abandonment.*—The Interstate Commerce Commission has authorized this company to abandon that part of its line extending from Autaugaville, Ala., easterly toward Forrester, 2.3 miles.

BANGOR & AROOSTOOK.—*Bonds.*—This company has applied to the Interstate Commerce Commission for authority to issue and sell $860,000 of 4 per cent consolidated refunding bonds, to be convertible into common stock.

CANADIAN PACIFIC.—*Preliminary Annual Report.*—This company in its preliminary report for 1935 shows gross revenues at $129,678,904, as compared with $125,542,954 for 1934. Net operating revenues, however, show a decrease of $1,986,499, being reported at $22,397,524, against $24,384,023 for 1934, as a result of an increase in operating expenses from $101,158,931 for 1934 to $107,281,380 for 1935.

Special income for 1935 is shown at $8,145,494, as compared with $6,663,793 for the preceding year. After deduction of provision for depreciation of ocean and coastal steamships at $3,550,997, and payment of fixed charges at $24,159,983, the balance of income account transferred to profit and loss is shown at $2,832,083. The comparable figure for 1934 was $2,686,130. The results for 1935 therefore show an improvement of $145,953 over the comparable figure for the previous year.

CHESAPEAKE & OHIO.—*Sinking Fund.*—Under the operation of the sinking fund for this company 5 per cent bonds due 1947, a total of $1,085,000 of the bonds have been drawn for redemption May 15. As provided in the indenture, holders of these bonds drawn by lot up to and including May 15 may convert them into common stock.

COLORADO & SOUTHERN.—*Abandonment.*—Examiner J. S. Prichard has submitted to the Interstate Commerce Commission a proposed report authorizing this company to abandon a branch line extending from Connors, Colo., to Falcon, 65.2 miles.

LOUISVILLE & NASHVILLE.—*Bonds.*—This company has applied to the Interstate Commerce Commission for authority to procure authentication and delivery of $30,000,000 of 4 per cent first and refunding mortgage series D bonds to be exchanged for an equivalent amount of 4½ per cent bonds, and to sell $9,292,000 of these bonds to retire a like amount of South & North Alabama consolidated bonds due August 1.

MISSOURI PACIFIC.—*Abandonment.*—The Interstate Commerce Commission has authorized this company to abandon a branch line extending from Ozark Junction, Ark., to Hartman Junction, 12.3 miles.

MINNEAPOLIS & ST. LOUIS.—*Abandonment.*—The Interstate Commerce Commission has authorized the co-receivers of this company to abandon operation of that portion of a branch line extending from St. Benedict to Algona, Iowa, 8.5 miles. The commission dismissed that part of the application seeking permission to abandon the operation of that portion of the branch between St. Benedict and Corwith, 6.6 miles.

MISSOURI PACIFIC.—*Abandonment.*—The trustees of this company and the Boonville, St. Louis & Southern have been authorized by the Interstate Commerce Commission to abandon a line extending from Boonville, Mo., through Tipton to Versailles, 43 miles.

MAINE CENTRAL.—*Annual Report.*—The 1935 annual report of this road shows net income, after interest and other charges, of $134,541, an increase of $99,290 over net income for 1934. Selected items from the Income Account follow:

	1935	Increase or Decrease
Average Mileage Operated	1,046	.....
RAILWAY OPERATING REVENUES	$11,431,532	+$500,466
Maintenance of way	1,628,147	−37,637
Maintenance of equipment	1,918,534	+180,989
Transportation	4,257,776	+230,766
TOTAL OPERATING EXPENSES	8,406,898	+406,754
Operating ratio	73.54	+.35
NET REVENUE FROM OPERATIONS	3,024,634	+93,711
Railway tax accruals	592,639	+19,172
Railway operating income	2,430,968	+74,953
Equipment and Joint facility rents—Net Dr.	621,236	+103,291
NET RAILWAY OPERATING INCOME	1,809,731	−28,337
Non-operating income	510,830	+157,542
GROSS INCOME	2,320,562	+129,204
Rent for leased roads	703,184	−47,394
Interest on funded debt	1,274,825	+9,326
TOTAL DEDUCTION FROM GROSS INCOME	2,186,020	+29,914
NET INCOME	$134,541	+$99,290

NEW YORK, SUSQUEHANNA & WESTERN.—*Annual Report.*—The 1935 annual report of this company shows net deficit, after interest and other charges, of $296,214, as compared with net deficit of $218,207 in 1934. Selected items from the Income Statement follow:

	1935	1934	Increase or Decrease
Average Mileage Operated	215.27	.....	.....
RAILWAY OPERATING REVENUES	$3,529,468	$3,606,659	−$77,191
Maintenance of way	319,368	427,789	−108,421
Maintenance of equipment	537,773	687,857	−150,083
Transportation	1,459,803	1,436,511	+23,292
TOTAL OPERATING EXPENSES	2,528,254	2,748,993	−220,739
Operating ratio	71.63	76.22	−4.59
NET REVENUE FROM OPERATIONS	1,001,214	857,665	+143,548
Railway tax accruals	257,156	261,775	−4,618
Railway operating income	742,201	593,152	+149,049
Net rents—Dr.	358,223	249,966	+135,257
NET RAILWAY OPERATING INCOME	356,977	343,185	+13,791
Non-operating income	63,661	72,893	−9,232
GROSS INCOME	420,638	416,079	+4,559
Rent for leased roads	27,248	26,604	+644
Interest on funded debt	755,847	756,582	−635
NET INCOME (deficit)	$379,342	$385,038	−$5,695

NEW YORK CENTRAL.—*Securities.*—This company has applied to the Interstate Commerce Commission for authority to issue $40,000,000 of 10-year secured sinking fund 3¾ per cent notes; $15,000,000 of serial secured notes (interest varying from 1½ to 2.6 per cent), and $7,900,000 of 5-year 3 per cent notes; and to pledge as security for these issues $62,900,000 of its refunding and improvement mortgage 5 per cent bonds, due 2013. The proceeds of the issues would be used to refund demand loans from banks upon which interest at 4 per cent is being paid.

NEW YORK, NEW HAVEN & HARTFORD.—*To Pay Interest.*—Trustees of this company, following authorization by the Court, have ordered payment of interest on two underlying issues—the New England R. R. 4 per cents and 5 per cents, due 1945, and the Central New England 4 per cents due 1961.

PENNROAD CORPORATION.—*1935 Earnings.*—This company has reported net income of $1,713,277 for 1935, an increase of $592,361 over the preceding year. A dividend totaling $1,818,000 was paid in December, 1935.

PORT ANGELES WESTERN.—*R.F.C. Loan Denied.*—The Interstate Commerce Commission has denied the application of this company for authority to borrow $784,500 from the Reconstruction Finance Corporation.

READING.—*Bonds.*—The Interstate Commerce Commission has authorized the North Pennsylvania to extend, and to the Reading to assume liability for, the maturity date of $1,500,000 of Northern Pennsylvania bonds from May 1, 1936, to January 1, 1953. Interest during the extended period is to be at the rate of 3½ per cent and the issue is authorized for sale at par, proceeds to be used to repay advances by the Reading.

ST. LOUIS SOUTHWESTERN.—*Abandonment.*—The Interstate Commerce Commission has authorized this company and its trustee to abandon a branch line extending from Hancock Junction, Ark., to Mandalay, 3.7 miles.

ST. LOUIS SOUTHWESTERN.—*Abandonment of Trackage Rights.*—The Interstate Commerce Commission has authorized this company and its trustee to abandon operation under trackage rights over the Missouri Pacific between McDonald, Ark., and Bridge Junction, 31 miles.

TIONESTA VALLEY.—*Abandonment.*—The Interstate Commerce Commission has authorized this company to abandon that part of its line extending from Sheffield, Pa., to Clarendon, 7.2 miles.

TUCKERTON.—*Abandonment.*—The Interstate Commerce Commission has authorized this company to abandon as to interstate and foreign commerce its entire line extending from Whitings, N. J., to Tuckerton, 28.9 miles.

UNION PACIFIC.—*Abandonment.*—The Interstate Commerce Commission has

authorized this company and the Des Chutes R. R. to abandon a line from Ainsworth, Oreg., to North Junction, 71.3 miles, and for either the Des Chutes R. R. or the Union Pacific to operate under trackage rights over the Oregon Trunk Ry. between Oregon Trunk Junction and North Junction, 74.8 miles.

VIRGINIAN.—*Bonds.*—A syndicate headed by Brown, Harriman & Co. is offering, subject to the approval of the Interstate Commerce Commission, an issue of $60,344,000 of first lien and refunding 3¾ per cent series A bonds of this company, due 1966, at 102¼ and accrued interest. The proceeds of the issue will be used in part to redeem at 110 on May 1 $55,344,000 of the company's 5 per cent bonds and $5,000,000 of 4½ per cent bonds at 102½.

WASHINGTON & OLD DOMINION.—*Acquisition.*—The Interstate Commerce Commission has authorized the receiver of the Washington & Old Dominion Ry. to abandon as to interstate and foreign commerce its entire line extending from Rosslyn, Va., to Bluemont Junction, 5 miles, and to abandon operation of the Southern's Bluemont branch, extending from Alexandria to Bluemont, 54 miles. The Washington & Old Dominion R. R. has been authorized to acquire the railway company's line and to operate the Southern's Bluemont branch. The railroad company has been authorized to issue $35,000 of stock in connection with this acquisition.

WESTERN PACIFIC.—*R.F.C. Loan.*—Jesse H. Jones, chairman of the Reconstruction Finance Corporation has addressed a letter to the trustees of this company reading in part as follows: "You are advised that subject to prior approval by the Interstate Commerce Commission, and authorization by the Court, this corporation will buy, at par and accrued interest, all or any part of the proposed issue of $3,000,000 trustees' certificates, allowing you first to offer the certificates to the bondholders interested in the road; the certificates to bear interest at the rate of 4 per cent, and the proceeds used by the trustees for such necessary purposes as may be approved by the Court. If application for sale of the certificates is made to the Public Works Administration, this corporation will, upon request of the administrator, buy all or any part of such certificates from him, at par and accrued interest."

Average Prices of Stocks and of Bonds

	Mar. 10	Last week	Last year
Average price of 20 representative railway stocks..	48.83	50.03	28.05
Average price of 20 representative railway bonds..	81.06	81.48	71.48

Dividends Declared

Alabama & Vicksburg.—Capital, 3 per cent, semi-annually, payable April 1 to holders of record March 9.

St. Joseph, South Bend & Southern.—5 Per Cent Preferred, $2.50, semi-annually, payable March 16 to holders of record March 10.

St. Louis, Rocky Mountain & Pacific.—25c; Preferred, $1.25, both payable March 31 to holders of record March 16.

Vicksburg, Shreveport & Pacific.—Preferred, 2½ per cent, semi-annually; Common, 2½ per cent, semi-annually; both payable April 1 to holders of record March 9.

Railway Officers

EXECUTIVE

L. A. Watkins, general attorney and general auditor of the Missouri & Arkansas, with headquarters at Harrison, Ark., has been elected vice-president.

FINANCIAL, LEGAL AND ACCOUNTING

Omar Josefe has been appointed secretary and **Carlos Duplan** has been appointed assistant secretary of the National Railways of Mexico, with headquarters at Mexico, D. F.

William I. Woodcock, Jr., whose appointment as general counsel of the Reading was noted in the *Railway Age* of March 7, was born at Hollidaysburg, Pa., on March 12, 1893. Mr. Woodcock was graduated from Lafayette College in June,

William I. Woodcock, Jr.

1916, and from the University of Pennsylvania School of Law in September, 1921. He was associated with Evans, Bayard & Frick from September, 1921, to November, 1922, when he entered the service of the Reading as counsel. He was appointed assistant general solicitor on January 1, 1927. On March 1, 1929, Mr. Woodcock was appointed general solicitor, the position he held until his recent appointment as general counsel, with headquarters at Philadelphia, Pa.

OPERATING

B. F. Wells has been appointed assistant superintendent of the Wyoming division of the Union Pacific, with headquarters at Green River, Wyo., succeeding **F. P. Flesher,** who has been assigned to other duties. **T. E. Williams,** superintendent of the Wyoming division, has had his headquarters transferred from Green River to Cheyenne, Wyo.

H. H. Harsh, division engineer of the Akron division of the Baltimore & Ohio, with headquarters at Akron, Ohio, has been promoted to assistant superintendent of the Chicago division, with headquarters at Garrett, Ind., succeeding **A. H. Freygang,** deceased. In an announcement of this appointment, which was published in the *Railway Age* of February 29, Mr. Harsh's name was given incorrectly as H. H. Hersh.

TRAFFIC

George W. Whitworth, passenger agent on the Missouri-Kansas-Texas with headquarters at St. Louis, Mo., has been appointed general agent, passenger department, with headquarters at Detroit, Mich., succeeding **J. Thomann,** who has resigned.

G. H. Shields, general agent for the Chicago Great Western at Kansas City, Mo., has been appointed assistant general freight agent, with the same headquarters, succeeding **E. C. Bywater,** who has resigned. **S. M. Lundberg,** assistant general agent at Kansas City, has been appointed general agent at that point, to succeed Mr. Shields.

S. K. Burke, assistant general freight agent on the Southern Pacific, with headquarters at San Francisco, Cal., has been appointed assistant to vice-president, system freight traffic, with the same headquarters. **C. E. McInnis** has been appointed assistant general freight agent at El Paso, Tex., succeeding **W. H. Francis,** who has been transferred to Portland, Ore., to replace **L. A. Brockwell,** who has been transferred to San Francisco to succeed Mr. Burke. **F. A. Smith** has been appointed assistant general freight agent at San Francisco.

ENGINEERING AND SIGNALING

J. P. Muller, signal engineer for the Boston & Maine, with headquarters at Boston, Mass., has had the scope of his jurisdiction enlarged to include the telegraph and telephone department and his title has been changed to engineer of signals and telegraph.

MECHANICAL

John F. Murphy has been appointed superintendent of the Boston & Albany shops at West Springfield, Mass., succeeding the late **John H. Minette.** Mr. Murphy was born in Springfield in 1880. He entered railroad service May 1, 1898, as a helper in the enginehouse at West Springfield. In 1902 he was transferred to the back shops where he served his apprenticeship as a machinist. In 1912, he was made foreman of the machine shop, remaining in that capacity until 1928, when he was made assistant shop superintendent.

OBITUARY

O. F. Johnson, freight traffic manager of the Lehigh Valley, with headquarters at New York, died on March 9 at Loomis, N. Y., after a long illness. Mr. Johnson was born at Hopkinton, Mass., on August 11, 1886, and entered the service of the Lehigh Valley on April 1, 1902, as clerk.

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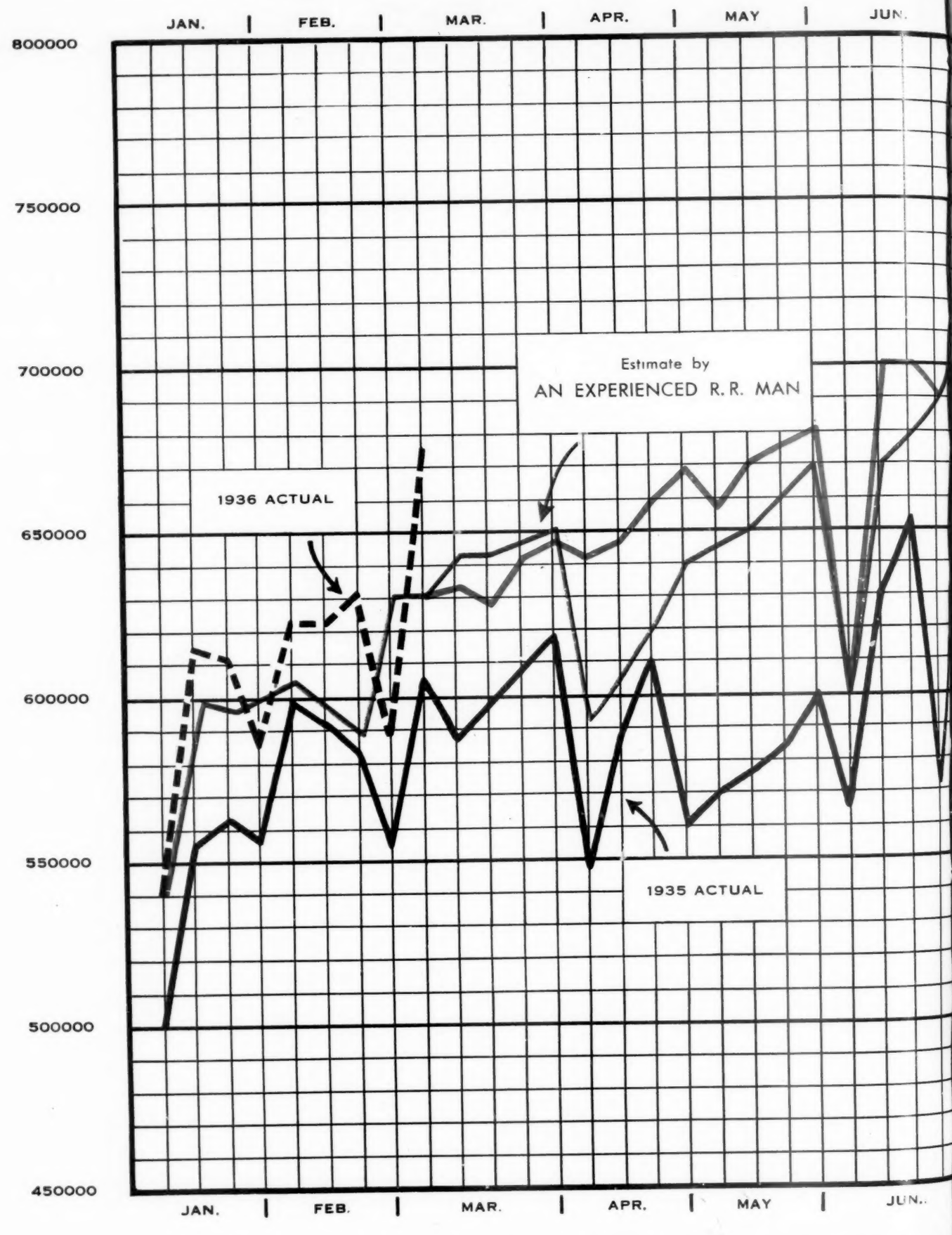
AMERICAN LOCOMO



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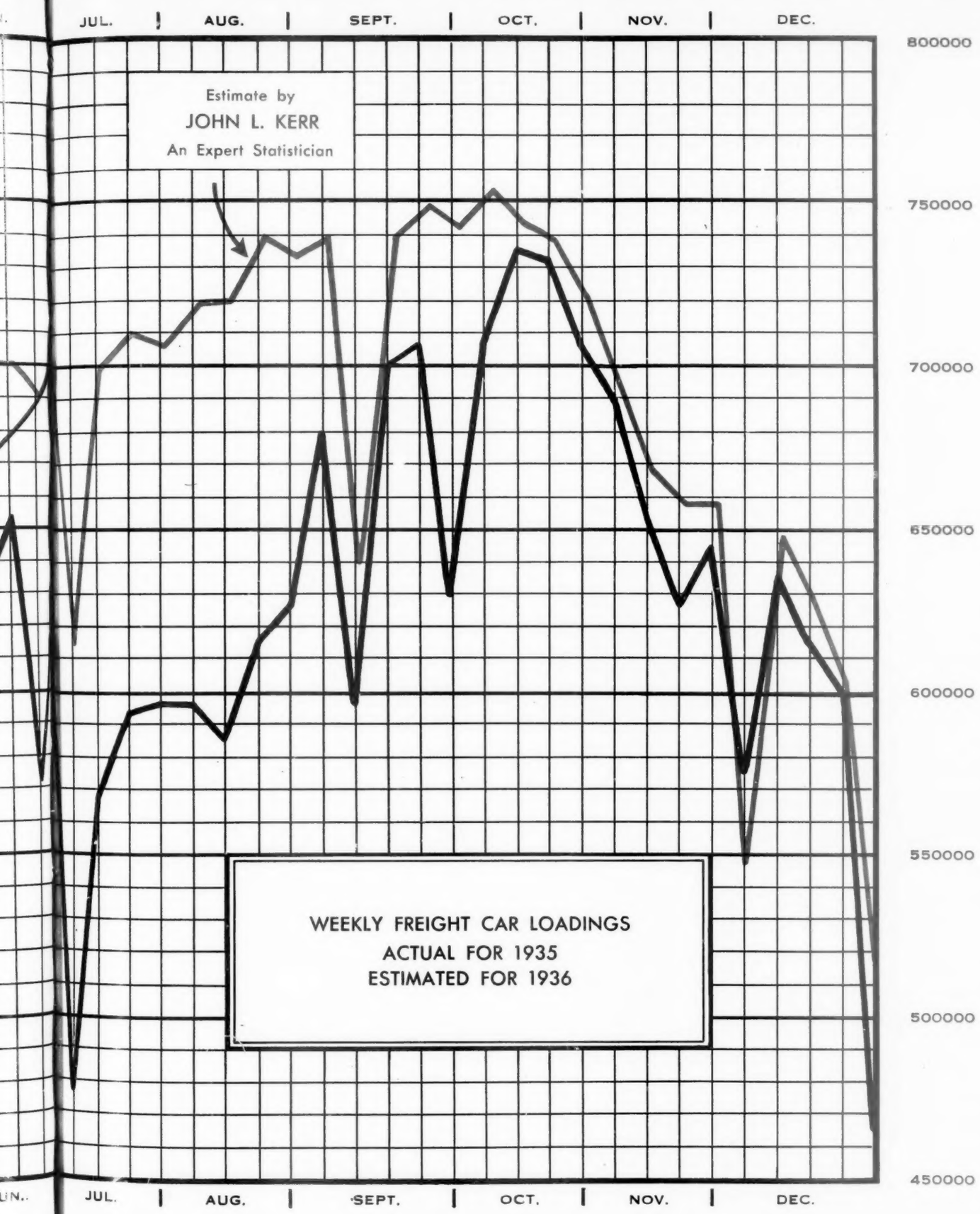
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Estimate by
JOHN L. KERR
An Expert Statistician
WEEKLY FREIGHT CAR LOADINGS
ACTUAL FOR 1935
ESTIMATED FOR 1936
JUL.
AUG.
SEPT.
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NOV.
DEC.

He served in various capacities until his appointment as chief clerk to the general freight agent, which position he held at the outbreak of the war. After service in the U. S. Army, Mr. Johnson re-entered the employ of the Lehigh Valley and in 1926 he was appointed freight traffic manager.

Benton M. Bukey, assistant passenger traffic manager of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, died on March 5 in a hotel at Los Angeles, Cal. Mr. Bukey had been connected with the Santa Fe for more than 29 years. He was born on November 6, 1879, at Williamstown, W. Va., and after a public school education, he entered railway service in November, 1899, with the Southern at Washington, D. C. Subsequently Mr. Bukey was employed by the Chicago, Burlington & Quincy at Chicago, and by the Missouri Pacific and the Missouri-Kansas-Texas at St. Louis, Mo. He entered the service of the Santa Fe in October, 1906, as a rate clerk in the office of the passenger traffic manager, being promoted to chief clerk to the passenger traffic manager in 1909 and thence to assistant general passenger agent in November, 1915. During federal control of the railroads Mr. Bukey served on the staff of the director of traffic of the United States Railroad Administration as assistant to the director of inland traffic for the Navy Department. Following the return of the railroads to private control Mr. Bukey resumed his position of assistant general passenger agent of the Santa Fe. From October 1, 1929, until his death he held the position of assistant passenger traffic manager.

Benton M. Bukey

Harry L. Reed, executive general agent for the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, and until recently general manager of this company, died of heart failure at Des Moines on March 8. Mr. Reed had been connected with the Rock Island continuously for 33 years. He was born on November 19, 1871, at Macon, Mo., and received his higher education at Thayer college at Kidder, Mo. He entered railway service in March, 1890, as a clerk to the chief dispatcher on the Chicago, Burlington & Quincy at Brookfield, Mo., later being advanced to train dispatcher. On February 1, 1903, Mr. Reed left the Burlington to enter the service of the Rock Island as chief dispatcher at Rock Island, Ill., later being transferred to Trenton, Mo. Subsequently he was advanced to trainmaster at Trenton and in May, 1906, he was further promoted to superintendent, serving in this capacity on the St. Louis, El Paso, Illinois, Nebraska and Kansas divisions until 1917, when he was promoted to general superintendent at El Reno, Okla. In May, 1924, Mr. Reed was transferred to Des Moines, being appointed general manager of the First district, with the same headquarters, in August, 1928. In July, 1932, when the position of system general manager was established, Mr. Reed was appointed to that position, with headquarters at Kansas City. Since February 15, 1936, he had served as executive general agent at Des Moines.

Harry L. Reed

A Former Commissioner's Views of the Passenger Fare Decision

This writer will say frankly that, in making the order in this [passenger fare] case, the Commission makes a precedent in the seizure of power for which there is no parallel in its history of nearly fifty years, despite its many reversals in the Supreme Court. The logic which will compel a railroad to carry passengers at a rate substantially less than the admitted present cost would, if pushed to its ultimate conclusions, make any rate for freight or passenger traffic illegal under Section 1 of the Act if in the judgment of the Commission the net revenue of the railroad would be increased by reducing the rate. Such logic seems to be in plain contravention to the spirit and the letter of the Transportation Act, and it is devoutly to be hoped that the order in this case will be taken to the courts for review. If the law is held by the courts to warrant the order, then there is no sense in continuing a system of private ownership and operation of railroads, and we might as well go at once to public ownership.

It is needless to waste time or breath discussing the arguments of the parties and of the Commission as to the probable effect of the reduction on the revenues of the Eastern carriers. (As a matter of fact, this writer many months ago suggested that the rail carriers might well make the experiment of lowering passenger rates in the hope of increasing revenues.) But that aspect of the matter has no relevance to the main point, namely, the power of the Commission to make this particular order.

Many of the Commission's decisions in the matter of "reasonableness" of freight rates have been inconsistent with each other in a degree quite impossible of comprehension.

Rates have been prescribed as reasonable maxima in some cases on a scale which in other cases were found to be hardly compensatory in fourth-section cases. For example: In 1933 the Commission established as maximum reasonable rates on sheep and goats from points in Arizona to St. Joseph and Kansas City a scale which for a distance of 1,400 miles yielded 12.6 cents a car-mile. In 1931 the Commission established a minimum of 12 cents a car-mile under fourth-section relief on traffic between Los Angeles and Portland, loading less than 40,000 lbs. per car (sheep and goats load about half this) on the ground that this was the lowest rate that would pay "out of pocket" costs on the added traffic. Only recently in the citrus fruit case the Commission permitted—under sharp minority protest—the railroads to go as low (under fourth-section relief) as 12 cents a car-mile for a distance of over 1,200 miles, this seemingly being its notion of a minimum compensatory rate on added traffic. In 1931 it prescribed (under fourth-section relief) a minimum rate on sulphur which produced 21 cents a car-mile for a distance of 645 miles. How such maxima and minima can be reconciled on any "reasonable" basis passes the wit of man to say. But the order in the present case opens entirely new ground. It is an altogether new chapter in ratemaking with limitless possibilities. Shall we, perhaps, open also a new chapter in the field of "reparation"? If a rate paid on freight by a shipper is found to violate Section 1 on grounds similar to those supporting the present order—namely, that if reduced it would give the carrier more revenue—has not the shipper been "damaged" by the payment of that rate, and is he not entitled to reparation?

If not—why not?

Thomas F. Woodlock in Wall Street Journal.

Revenues and Expenses of Railways

MONTH OF JANUARY OF CALENDAR YEAR 1936

Name of road		Av. mileage operated during period	Operating revenues: Freight	Passenger	Total (inc. misc.)	Operating expenses: Maintenance of Way and structures	Maintenance of Equipment	Traffic	Transportation	Total	Operating ratio	Net from railway operation	Operating income	Net railway operating income: After depr.& retir. 1936	1935	Before depr.& ret.
Akron, Canton & Youngstown	Jan.	171	$177,776	$63	$187,172	$26,069	$17,234	$8,250	$54,011	$114,557	61.2	$72,615	$62,493	$45,620	$52,450	$50,110
Alton	Jan.	956	855,335	182,756	1,204,492	118,458	209,268	44,005	522,258	958,051	79.5	246,441	176,444	19,898	—19,580	47,110
Atchison, Topeka & Santa Fe System	Jan.	13,234	8,841,171	1,207,352	10,983,199	1,468,813	2,873,491	403,837	4,323,882	9,546,122	86.9	1,437,077	508,272	480,607	—101,415	1,425,784
Atlanta & West Point	Jan.	93	93,882	24,191	138,419	20,926	25,162	7,556	60,916	124,202	89.7	14,217	7,069	—4,560	—9,986	6,832
Western of Alabama	Jan.	133	81,193	26,386	121,784	20,615	28,648	7,157	52,314	117,393	96.4	4,391	—4,631	—25	—12,953	15,466
Atlanta, Birmingham & Coast	Jan.	639	217,554	23,754	271,214	42,433	48,760	21,482	108,367	245,392	90.5	25,822	12,015	—1,286	—42,053	11,439
Atlantic Coast Line	Jan.	5,145	2,554,263	717,946	3,714,476	443,212	747,678	149,548	1,554,464	3,100,625	83.5	613,851	188,851	63,556	103,457	244,137
Charleston & Western Carolina	Jan.	342	167,555	1,472	173,801	24,931	26,863	6,200	60,957	123,684	71.2	50,117	32,617	30,750	22,735	37,054
Baltimore & Ohio	Jan.	6,439	10,845,952	890,914	12,465,656	862,370	2,869,699	338,156	4,656,789	9,392,993	75.4	3,072,663	2,386,246	2,031,324	1,783,493	2,649,785
Staten Island Rapid Transit	Jan.	23	51,582	75,419	134,130	15,062	21,165	1,859	92,870	143,745	107.2	—9,615	—28,865	—45,243	—60,563	—37,841
Bangor & Aroostook	Jan.	603	600,518	23,245	643,551	106,797	91,524	5,061	165,831	392,013	60.9	251,538	196,367	182,358	246,337	204,495
Bessemer & Lake Erie	Jan.	225	442,957	990	455,752	43,174	267,337	10,840	143,582	503,601	110.5	—47,849	—63,029	—8,548	—93,923	45,568
Boston & Maine	Jan.	1,997	2,623,015	580,988	3,684,095	543,352	742,648	63,762	1,627,368	3,173,351	86.1	510,744	288,495	99,128	83,949	236,165
Brooklyn Eastern District Terminal	Jan.	10.75	90,073	.....	92,378	3,676	6,182	298	28,702	44,507	47.66	47,871	38,967	39,123	31,625	.....
Burlington, Rock Island	Jan.	255	64,239	4,387	73,456	14,908	15,220	4,440	38,934	81,246	110.6	—7,790	—14,132	—25,412	—22,975	—23,093
Cambria & Indiana	Jan.	37	123,895	.....	124,044	5,894	36,344	367	15,282	63,577	51.25	60,467	32,857	105,713	99,310	121,653
Canadian Pacific Lines in Maine	Jan.	233	221,246	13,801	246,573	32,900	54,939	10,249	102,793	208,262	84.4	38,311	31,311	8,091	3,833	10,126
Canadian Pacific Lines in Vermont	Jan.	85	64,377	9,715	83,897	16,840	26,383	4,556	61,257	114,575	136.5	—30,678	—35,678	.....	.....	—55,994
Central of Georgia	Jan.	1,926	951,426	124,432	1,214,347	155,251	281,947	51,890	532,942	1,105,933	91.1	108,414	27,560	—348	—15,901	63,927
Central of New Jersey	Jan.	681	2,150,761	330,567	2,626,986	200,444	469,755	42,092	1,134,511	1,960,038	74.61	666,948	392,532	257,948	190,021	385,453
Central Vermont	Jan.	455	364,366	38,203	444,446	61,844	80,914	14,686	230,788	411,124	92.5	33,322	19,171	27,229	—54,818	55,738
Chesapeake & Ohio	Jan.	3,106	9,786,706	261,128	10,325,469	1,009,238	1,842,405	179,462	2,356,932	5,701,687	55.2	4,623,782	3,659,190	3,811,702	2,660,644	4,511,461
Chicago & Eastern Illinois	Jan.	931	1,061,452	113,045	1,314,680	134,075	228,858	54,003	522,026	1,000,051	76.1	314,629	239,629	89,819	39,314	139,978
Chicago & Illinois Midland	Jan.	131	293,195	1,549	300,809	26,435	59,643	21,433	82,652	207,310	68.9	93,499	79,061	81,315	57,158	94,952
Chicago & North Western	Jan.	8,355	4,774,693	795,030	6,258,320	698,708	1,416,806	149,377	2,856,081	5,453,361	87.1	804,959	257,959	85,527	—57,017	500,758
Chicago, Burlington & Quincy	Jan.	9,025	5,866,208	608,073	7,210,313	638,958	1,372,710	208,191	2,847,470	5,419,340	75.2	1,790,973	1,230,042	899,305	198,228	1,281,724
Chicago Great Western	Jan.	1,512	1,154,308	52,168	1,301,927	218,842	192,254	53,689	586,616	1,105,478	84.9	196,449	139,183	—27,886	—125,109	13,100
Chicago, Indianapolis & Louisville	Jan.	572	695,479	51,619	836,524	63,211	176,944	28,189	343,010	645,034	77.1	191,490	163,309	64,249	—28,819	106,043
Chicago, Milwaukee, St. Paul & Pac.	Jan.	11,123	6,797,264	559,002	8,128,185	779,838	1,576,659	203,742	3,369,784	6,265,992	77.1	1,862,193	1,300,193	855,178	—196,407	1,305,314
Chicago, Rock Island & Pacific	Jan.	7,574	4,307,341	622,274	5,481,966	542,182	1,407,504	188,697	2,552,959	5,079,241	92.7	402,725	11,113	—226,881	—483,339	132,888
Chicago, Rock Island & Gulf	Jan.	626	237,361	28,421	335,777	42,679	39,372	15,795	127,670	248,644	74.1	87,133	69,678	19,932	—18,599	24,080
Chicago, St. Paul, Minn. & Omaha	Jan.	1,651	1,122,596	128,281	1,346,086	125,264	245,541	33,943	746,820	1,231,046	91.5	115,040	31,424	—61,834	—88,166	—11,862
Clinchfield Railroad	Jan.	309	541,088	4,045	551,065	37,104	97,369	16,767	117,331	281,884	51.2	269,181	229,663	260,954	181,717	304,577
Colorado & Southern	Jan.	1,019	434,540	26,494	515,481	46,496	96,812	11,959	235,496	425,540	82.6	89,941	33,973	15,291	—27,693	47,172
Fort Worth & Denver City	Jan.	902	441,408	39,038	481,864	40,134	102,127	16,593	153,501	348,330	72.3	133,534	104,428	72,123	9,393	89,917
Columbus & Greenville	Jan.	167	75,079	6,126	86,680	16,845	15,004	3,706	35,648	82,060	94.7	4,620	2,046	475	—13,631	3,269
Delaware & Hudson	Jan.	831	1,847,985	103,659	2,028,837	264,117	490,251	45,412	833,485	1,775,936	87.5	252,901	147,377	146,972	71,725	241,631
Delaware, Lackawanna & Western	Jan.	994	2,914,052	581,443	3,923,517	276,201	793,418	115,573	1,947,021	3,320,904	84.6	602,613	268,613	255,305	316,012	478,268
Denver & Rio Grande Western	Jan.	2,584	1,595,552	130,830	1,813,184	109,084	504,933	49,591	655,095	1,406,038	77.5	407,146	245,646	211,342	161,564	310,082
Denver & Salt Lake	Jan.	232	243,884	6,314	258,607	19,595	52,957	2,204	58,682	142,331	55.0	116,276	99,956	133,668	105,061	139,041
Detroit & Mackinac	Jan.	242	33,045	3,666	41,940	6,369	9,297	874	23,090	42,849	102.2	—909	—2,988	—5,155	—8,098	—2,190
Detroit & Toledo Shore Line	Jan.	50	397,421	.....	399,538	17,186	25,997	7,239	89,117	146,669	36.7	252,869	211,570	147,584	125,469	153,143
Detroit, Toledo & Ironton	Jan.	472	731,591	214	743,453	51,171	74,645	10,412	149,892	305,737	41.1	437,716	361,203	317,030	349,908	338,815
Duluth, Missabe & Northern	Jan.	559	76,727	3,127	98,035	108,512	188,316	4,004	137,262	485,153	494.9	—387,118	—426,679	—435,569	—417,762	—360,522
Duluth, Winnipeg & Pacific	Jan.	178	136,989	2,512	142,296	15,326	20,522	1,742	56,735	98,375	69.1	43,921	36,223	17,569	—10,656	20,753
Elgin, Joliet & Eastern	Jan.	434	1,230,936	.....	1,372,353	113,430	291,839	13,581	504,359	968,532	70.6	403,821	301,852	285,182	175,410	360,549

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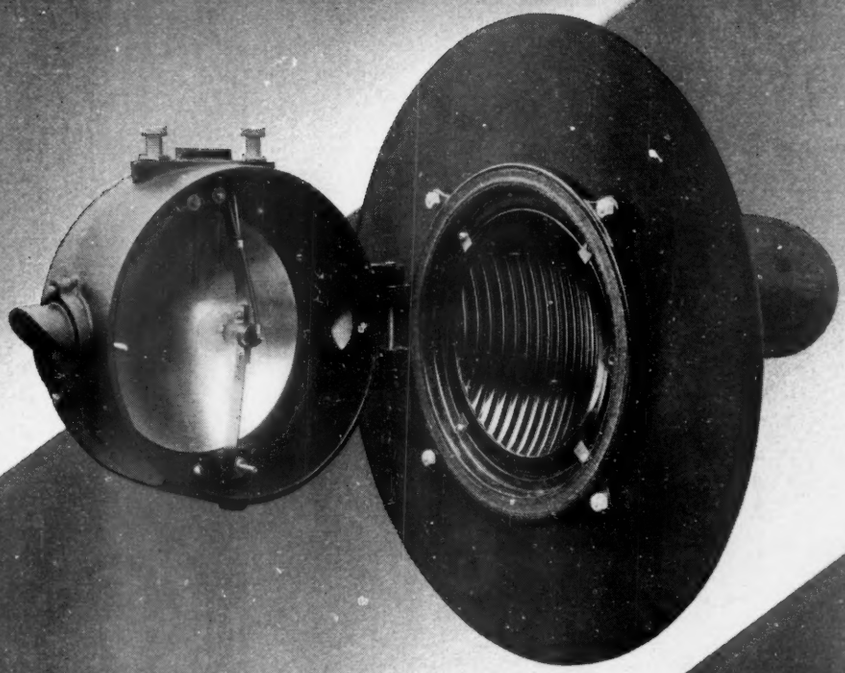
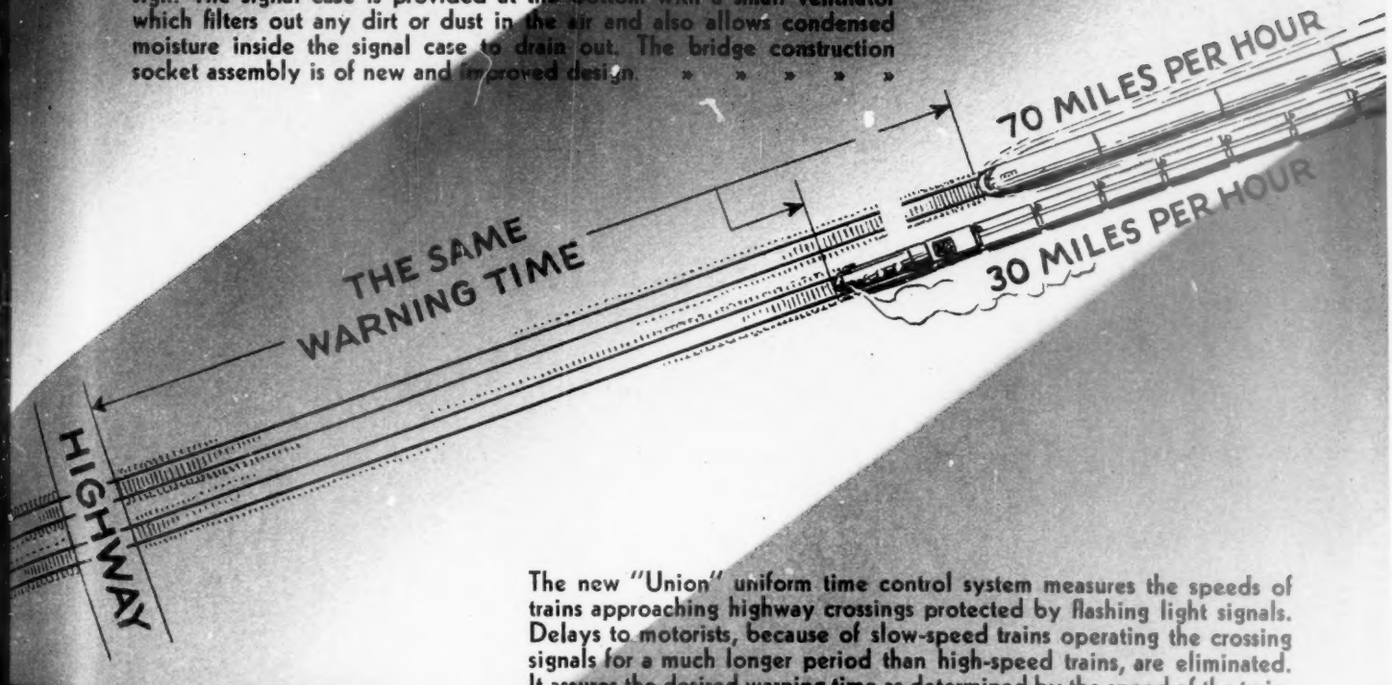


The new "Union" HC-81 Flashing Light Highway Crossing Signal was designed for those crossings where a backlight indication of the same intensity and spread as the front indication is desired. The new signal incorporates improvements in its optical arrangement, mechanical design and in economy, not found in previous designs. Its 8-in. diameter, shallow, parabolic glass reflector has its silvered backing protected in an entirely new manner. Other outstanding improvements are incorporated in its design. The signal case is provided at the bottom with a small ventilator which filters out any dirt or dust in the air and also allows condensed moisture inside the signal case to drain out. The bridge construction socket assembly is of new and improved design. » » » » »



The new "Union" uniform time control system measures the speeds of trains approaching highway crossings protected by flashing light signals. Delays to motorists, because of slow-speed trains operating the crossing signals for a much longer period than high-speed trains, are eliminated. It assures the desired warning time as determined by the speed of the train.

1881 1936

Revenues and Expenses of Railways

MONTH OF JANUARY OF CALENDAR YEAR 1936—CONTINUED

Name of road		Av. mileage operated during period	Operating revenues: Freight	Passenger	Total (inc. misc.)	Operating expenses: Maintenance of Way and structures	Maintenance of Equipment	Traffic	Transportation	Total	Operating ratio	Net from railway operation	Operating income	Net railway operating income: After depr. & retir. 1936	1935	Before depr. & ret.
Erie	Jan.	2,297	$5,359,946	$432,092	$6,219,045	$475,812	$1,259,050	$167,503	$2,506,026	$4,707,774	75.7	$1,511,271	$1,139,643	$918,495	$885,208	$1,244,480
New Jersey & New York	Jan.	45	16,144	48,675	66,474	4,231	14,563	590	52,277	73,152	110.0	—6,678	—10,828	—26,717	—37,425	—26,706
New York, Susque. & Western	Jan.	215	291,889	23,940	329,780	23,504	39,968	4,911	143,365	224,783	68.2	104,997	83,397	58,756	45,527	64,706
Florida East Coast	Jan.	712	491,038	266,275	861,343	100,633	144,175	25,366	280,760	613,052	71.2	248,291	177,983	146,800	447	204,171
Fort Smith & Western	Jan.	249	69,122	819	74,078	13,797	9,868	5,142	20,910	53,579	72.3	20,499	18,699	11,949	5,528	12,518
Georgia Railroad	Jan.	329	228,837	13,539	264,473	25,111	59,361	17,219	126,745	242,560	91.7	21,913	17,413	29,109	25,303	40,689
Georgia & Florida	Jan.	408	73,541	2,101	79,305	19,600	16,796	8,156	33,384	83,682	105.5	—4,377	—9,681	—10,445	—14,777	—5,219
Grand Trunk Western	Jan.	1,032	1,676,066	77,095	1,908,748	163,120	361,706	33,930	769,981	1,414,300	74.1	494,448	406,981	340,062	104,681	427,244
Canadian Nat'l Lines in New Eng.	Jan.	172	84,683	5,812	98,397	23,762	25,291	2,312	58,602	119,419	121.4	—21,022	—33,755	—59,648	—75,424	—57,356
Great Northern	Jan.	8,250	3,962,234	389,523	4,789,479	460,932	1,059,661	166,548	2,180,409	4,146,339	86.6	643,140	91,707	90,206	—364,759	394,112
Green Bay & Western	Jan.	234	120,968	777	125,728	26,743	14,864	6,048	46,014	98,144	78.0	27,584	21,060	15,025	7,745	19,236
Gulf & Ship Island	Jan.	259	80,735	6,112	96,981	17,747	15,831	3,735	54,532	97,458	110.5	—477	—14,281	—22,920	—30,345	—19,282
Gulf, Mobile & Northern	Jan.	936	499,363	20,679	541,054	66,272	93,498	34,444	155,060	378,787	70.01	162,267	129,267	71,972	—1,231	90,942
Illinois Central	Jan.	4,980	6,445,258	793,427	7,796,007	593,953	1,666,909	254,427	3,166,689	6,096,961	78.2	1,699,046	1,189,671	1,007,778	673,203	1,563,408
Yazoo & Mississippi Valley	Jan.	1,619	859,615	59,386	988,718	88,493	175,283	36,942	466,979	824,379	83.4	164,339	42,856	—38,995	—97,863	2,867
Illinois Central System	Jan.	6,606	7,304,873	852,813	8,784,725	682,446	1,842,192	291,369	3,633,668	6,921,340	78.8	1,863,385	1,229,703	973,783	584,840	1,571,275
Illinois Terminal	Jan.	519	382,786	67,701	484,669	41,943	64,784	16,259	169,432	311,342	64.24	173,327	143,488	125,668	61,889	144,630
Kansas City Southern	Jan.	878	850,829	16,584	960,788	79,321	155,334	47,891	291,597	645,547	67.2	315,241	240,241	187,014	16,397	215,421
Kansas Oklahoma & Gulf	Jan.	326	199,792	524	203,031	11,881	25,637	7,902	41,440	95,011	46.8	108,020	93,890	79,515	57,973	81,601
Lake Superior & Ishpeming	Jan.	160	37,531	89	39,992	21,834	28,425	595	23,601	80,594	202.0	—40,602	—55,020	—56,892	—55,114	—43,613
Lehigh & Hudson River	Jan.	96	121,502	108	122,222	10,124	20,299	3,307	49,551	89,884	73.5	32,338	22,036	9,547	18,766	13,332
Lehigh & New England	Jan.	219	308,049	344	310,282	31,826	71,012	6,121	118,249	242,967	78.3	67,315	55,173	54,697	75,929	72,858
Lehigh Valley	Jan.	1,336	3,385,922	226,375	3,864,490	250,505	672,004	111,584	1,784,499	2,984,886	77.2	879,604	676,802	486,393	604,067	678,782
Louisiana & Arkansas	Jan.	606	408,476	8,445	434,608	47,444	60,786	29,898	118,662	275,703	63.4	275,703	127,030	109,720	52,724	124,081
Louisiana, Arkansas & Texas	Jan.	255	87,023	170	89,541	18,926	8,678	4,449	28,967	65,531	73.2	24,010	21,523	7,963	—5,647	8,687
Louisville & Nashville	Jan.	5,009	6,098,859	525,354	7,138,679	731,308	1,684,822	197,865	2,555,359	5,492,230	76.9	1,646,449	1,233,949	1,289,842	1,027,236	1,638,323
Maine Central	Jan.	1,046	836,875	86,093	1,016,956	173,342	231,616	10,572	422,260	878,095	86.3	138,861	84,449	19,933	—23,490	64,627
Midland Valley	Jan.	361	143,633	44	145,118	8,908	8,113	2,472	32,110	58,169	40.1	86,949	80,615	70,076	43,276	72,185
Minneapolis & St. Louis	Jan.	1,624	603,037	15,665	651,211	51,691	121,907	35,152	317,832	563,831	86.6	87,380	59,058	26,616	—96,293	55,904
Minneapolis, St. Paul & S. S. Marie	Jan.	4,296	1,567,040	74,362	1,772,080	241,421	332,022	56,458	884,441	1,623,434	91.6	148,646	14,570	—101,546	—333,652	768
Duluth, South Shore & Atlantic	Jan.	550	137,303	11,764	159,241	28,750	33,304	4,323	80,741	151,943	95.4	7,298	—933	—7,942	—40,056	—94
Spokane International	Jan.	163	41,612	1,737	48,569	7,860	5,397	1,817	20,175	39,227	80.8	9,342	5,510	3,592	—12,751	4,664
Mississippi Central	Jan.	150	60,681	1,590	64,303	11,026	10,131	6,722	19,721	53,071	82.5	11,232	8,361	5,726	—4,519	7,962
Missouri-Arkansas	Jan.	364	64,068	1,246	71,087	16,446	10,037	5,357	28,711	65,347	91.9	5,740	4,172	—2,751	.....	—1,908
Missouri-Illinois	Jan.	208	81,448	602	83,789	11,885	12,276	2,303	29,608	61,096	72.9	22,693	17,487	9,749	4,031	13,125
Missouri-Kansas-Texas Line	Jan.	3,293	1,982,669	167,019	2,365,649	284,959	455,274	113,131	921,215	1,917,021	81.0	448,628	298,435	96,154	—314,237	203,232
Missouri Pacific	Jan.	7,228	5,984,303	376,531	6,905,604	712,406	1,337,116	239,960	2,678,702	5,263,394	76.2	1,642,210	1,293,755	821,671	101,009	1,172,933
Gulf Coast Lines	Jan.	1,763	1,073,309	31,279	1,157,111	152,795	179,922	42,230	333,525	754,816	65.23	402,295	352,667	219,737	231,874	.....
International Great Northern	Jan.	1,154	790,482	58,053	946,893	133,316	195,290	32,183	393,640	809,452	85.49	137,441	100,729	14,413	33,022	44,662
Mobile & Ohio	Jan.	1,201	649,347	25,490	724,358	93,823	143,682	43,801	297,933	620,530	85.7	103,828	68,255	13,774	—96,508	65,045
Monongahela	Jan.	174	354,618	1,018	358,372	30,771	31,622	420	90,607	157,037	43.8	201,335	181,675	93,201	83,089	99,291
Montour	Jan.	57	175,068	.....	177,359	9,046	38,940	937	48,496	104,207	58.8	73,152	56,838	68,863	58,134	79,793
Nashville, Chattanooga & St. Louis	Jan.	1,154	824,163	106,330	1,068,560	108,508	243,920	78,922	468,870	966,281	90.4	102,279	57,249	37,160	11,871	81,147
Nevada Northern	Jan.	165	41,932	999	47,770	8,220	3,928	936	10,434	27,457	57.5	20,313	13,446	16,119	—4,626	22,069
New York Central	Jan.	11,214	19,753,280	5,518,224	28,205,750	2,575,903	6,299,464	525,859	10,877,473	21,798,406	77.3	6,407,344	4,182,392	2,658,931	2,474,958	4,006,893
Pittsburgh & Lake Erie	Jan.	233	1,290,485	59,709	1,383,745	97,317	525,833	26,442	524,428	1,256,306	90.8	127,439	21,079	191,259	247,221	341,732
New York, Chicago & St. Louis	Jan.	1,704	2,954,696	76,993	3,139,944	244,909	476,998	113,784	1,129,453	2,095,943	66.8	1,044,001	898,140	643,669	504,168	776,842

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Revenues and Expenses of Railways

MONTH OF JANUARY OF CALENDAR YEAR 1936—CONTINUED

Name of road		Av. mileage operated during period	Operating revenues: Freight	Passenger	Total (inc. misc.)	Operating expenses: Maintenance of Way and structures	Maintenance of Equipment	Traffic	Transportation	Total	Operating ratio	Net from railway operation	Operating income	Net railway operating income: After depr.& retir. 1936	After depr.& retir. 1935	Before depr.& ret.
New York, New Haven & Hartford	Jan.	2,061	$3,474,345	$2,023,677	$6,188,922	$681,357	$1,106,631	$90,052	$2,432,352	$4,732,908	76.5	$1,456,014	$1,061,014	$509,101	$457,513	$794,036
New York Connecting	Jan.	20	228,126	.....	234,226	9,798	6,126	.....	29,216	47,195	20.1	187,031	152,931	121,841	110,106	121,841
New York, Ontario & Western	Jan.	566	769,534	6,640	838,543	73,258	140,109	9,940	375,775	628,998	75.0	209,545	172,545	133,844	157,318	158,661
Norfolk & Western	Jan.	2,166	6,453,148	170,636	6,825,304	763,809	1,091,999	114,428	1,691,324	3,883,793	56.9	2,941,511	2,139,101	2,355,950	1,320,963	2,729,172
Norfolk Southern	Jan.	835	294,074	6,665	316,406	63,020	49,331	22,575	131,160	287,014	90.7	29,392	4,585	—5,009	—17,282	5,668
Northern Pacific	Jan.	6,727	3,238,998	307,564	3,929,363	408,416	1,056,419	142,194	1,860,875	3,817,752	97.2	111,611	—368,419	—55,401	—382,225	201,085
Northwestern Pacific	Jan.	351	183,437	64,605	275,234	40,376	48,672	3,733	158,510	264,491	96.1	10,743	1,966	—2,775	—59,785	11,665
Oklahoma City-Ada-Atoka	Jan.	132	35,839	383	38,339	3,405	1,117	896	8,368	15,427	40.2	22,912	20,713	21,412	8,683	21,419
Pennsylvania	Jan.	10,442	23,910,397	6,140,391	32,921,236	3,255,409	6,777,797	607,514	12,493,977	25,074,937	76.2	7,846,299	6,046,659	5,334,211	4,862,610	7,110,843
Long Island	Jan.	396	489,858	1,273,371	1,835,354	174,758	375,452	21,590	1,019,823	1,654,169	90.1	181,185	52,256	—105,835	—170,252	—6,416
Pennsylvania-Reading Seashore Lines	Jan.	412	249,693	95,439	361,090	65,855	64,879	5,749	258,073	422,205	116.9	—61,115	—127,036	—197,586	—292,052	—190,293
Pere Marquette	Jan.	2,115	2,338,944	92,817	2,547,992	258,065	538,638	63,774	975,067	1,930,877	75.8	617,115	503,355	351,299	316,490	563,526
Pittsburg & Shawmut	Jan.	103	48,563	501	50,131	9,474	14,011	1,492	16,817	45,249	90.3	4,882	4,453	4,810	9,245	10,621
Pittsburgh & West Virginia	Jan.	138	261,463	.....	280,478	23,285	63,459	15,450	60,940	185,754	66.2	94,724	72,999	101,491	80,331	124,094
Pittsburg, Shawmut & Northern	Jan.	190	80,820	84	82,434	12,826	17,976	1,406	35,193	73,869	89.6	8,565	6,270	211	—3,849	2,911
Reading	Jan.	1,456	4,270,491	342,722	4,825,491	364,361	832,560	75,785	1,954,128	3,464,218	71.8	1,361,273	1,014,673	1,041,834	887,843	1,310,050
Richmond, Fredericksburg & Potomac	Jan.	117	271,004	225,901	603,686	69,739	124,466	9,686	269,598	522,206	86.5	81,480	53,729	3,614	942	30,400
Rutland	Jan.	407	158,311	32,018	240,759	39,386	57,911	10,295	140,677	262,979	109.2	—22,220	—35,206	—31,206	—38,235	—19,723
St. Louis-San Francisco	Jan.	4,929	3,091,513	249,708	3,653,844	515,200	856,295	107,414	1,379,055	3,024,297	82.8	629,547	383,149	417,611	—86,318	686,918
Fort Worth & Rio Grande	Jan.	233	32,256	762	39,672	15,997	9,252	2,717	24,989	56,421	142.2	—16,749	—20,110	—27,341	—26,672	—27,290
St. Louis, San Francisco & Texas	Jan.	261	85,723	734	90,458	42,035	12,315	5,100	44,820	111,643	123.4	—21,185	—24,889	—56,225	—55,693	—56,059
St. Louis Southwestern Lines	Jan.	1,784	1,305,107	17,508	1,375,965	126,022	225,777	78,544	463,620	961,753	69.9	414,212	340,197	207,072	208,875	257,573
San Diego & Arizona Eastern	Jan.						(DOES NOT FILE—CLASS II RAILROAD)									
Seaboard Air Line	Jan.	4,307	2,351,349	542,622	3,193,739	456,997	681,397	151,930	1,247,584	2,738,562	85.7	455,177	185,177	63,582	51,559	220,187
Southern Railway	Jan.	6,641	6,062,903	797,505	7,508,772	923,645	1,326,253	150,123	2,761,295	5,465,230	72.8	2,043,542	1,585,354	1,334,307	768,097	1,605,042
Alabama Great Southern	Jan.	315	367,140	43,247	445,925	76,594	91,335	11,866	154,930	353,794	79.3	92,131	59,655	44,780	878	68,021
Cinn., New Orleans & Texas Pacific	Jan.	336	992,004	140,083	1,203,191	165,923	219,934	24,088	329,432	787,731	65.5	415,460	328,630	311,601	234,809	361,538
Georgia Southern & Florida	Jan.	397	107,844	72,463	201,086	29,907	34,815	1,849	90,750	165,757	82.4	35,329	22,844	23,053	—7,052	30,115
New Orleans & Northeastern	Jan.	204	155,295	15,567	185,775	26,534	40,483	5,748	68,853	151,877	81.8	33,898	11,847	—6,113	—12,486	—6,113
Northern Alabama	Jan.	100	57,983	1,711	61,551	9,850	1,362	1,040	17,991	32,034	52.1	29,517	25,561	13,415	—3,102	13,486
Southern Pacific	Jan.	8,777	7,687,652	1,668,412	10,177,475	1,087,560	1,940,900	285,094	4,117,512	8,256,546	81.1	1,920,929	1,113,934	688,389	409,253	1,170,768
Southern Pacific Steamship Lines	Jan.	....	365,616	10,196	393,863	16,581	88,957	17,248	316,415	457,343	116.1	—63,480	—65,972	—66,224	—111,135	—30,921
Texas & New Orleans	Jan.	4,429	2,635,738	237,730	3,113,232	430,312	619,540	114,265	1,104,570	2,490,521	80.0	622,711	420,265	241,789	77,185	381,524
Spokane, Portland & Seattle	Jan.	946	449,181	34,233	528,149	61,451	75,244	7,488	218,913	390,286	73.9	137,863	72,697	21,616	349	38,157
Tennessee Central	Jan.	286	196,526	5,984	214,690	24,770	28,660	5,169	71,050	139,907	65.2	74,783	66,288	53,716	34,458	59,709
Texas & Pacific	Jan.	1,949	1,687,799	180,508	2,037,736	256,718	353,191	70,327	650,592	1,465,835	71.9	571,901	467,520	342,679	244,611	439,796
Texas Mexican	Jan.	162	93,846	385	103,975	17,657	14,176	3,538	34,554	77,465	74.5	26,510	22,625	17,514	57,008	19,327
Toledo, Peoria & Western	Jan.	239	160,051	13	162,316	32,498	10,874	16,599	45,664	113,778	70.1	48,538	40,138	24,443	6,278	35,739
Union Pacific System	Jan.	9,825	8,561,732	1,022,788	10,436,513	938,475	2,249,997	295,918	3,831,730	8,110,449	77.7	2,326,064	1,391,645	911,557	674,190	1,439,633
Utah	Jan.	111	138,535	.....	139,383	16,104	27,204	487	32,193	80,379	57.7	59,004	44,041	34,832	21,831	44,670
Virginian	Jan.	619	1,438,039	3,619	1,499,695	97,092	241,717	18,146	257,076	651,912	43.5	847,783	657,783	690,157	568,239	783,308
Wabash	Jan.	2,447	2,988,388	221,930	3,548,849	353,983	707,514	141,296	1,384,688	2,747,577	77.4	801,272	647,097	355,321	186,889	533,951
Ann Arbor	Jan.	293	301,251	3,087	311,321	24,959	70,079	12,165	142,262	262,058	84.2	49,263	33,839	21,776	19,639	41,940
Western Maryland	Jan.	883	1,340,779	7,233	1,383,729	157,342	314,886	38,303	353,471	918,002	66.3	465,727	380,727	402,554	351,520	497,575
Western Pacific	Jan.	1,207	882,185	34,083	937,172	127,995	195,555	55,704	418,946	842,464	89.9	94,708	35,389	—33,339	—39,867	18,283
Wheeling & Lake Erie	Jan.	511	1,078,952	2,179	1,137,598	103,038	328,771	30,681	358,330	853,264	75.0	284,334	186,825	201,685	174,075	303,067
Wichita Falls & Southern	Jan.	203	35,080	25	40,349	14,097	5,466	1,379	12,982	37,559	93.09	2,790	133	—1,649	—1,477	307